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Fungalpedia 2 – Basidiomycete genera and notes on mushroom mycelium-based biomaterials

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Abstract

Fungalpedia represents an ongoing serial compendium of the Fungi and fungus-like taxa, offering comprehensive outlines and taxonomic notes of genera and higher taxa, their applications, and standardized terminologies used in mycology. This study is divided into two sections: illustrated notes on 226 basidiomycete genera and definitions for 55 terminologies related to mushroom mycelium-based biomaterials. Fungal genera were selected that were established before 2008 when the last Dictionary of the Fungi was published. Each genus entry includes information on habit and habitat, classification, morphological characteristics, genetic markers, critical analysis of taxonomic placement, beneficial roles to human and nature and clarifies discrepancies in the main fungal classification and nomenclature databases. Additionally, brief notes on their families are provided. Line drawings are provided for nearly all entries to aid identification. This study is the first formal compilation of terms commonly used in the mycelium-based biomaterial sector, featuring their definition, implications, and necessary diagrams. This effort contributes to the integration of traditional mycology and innovative and sustainable material science.

Keywords – *Agaricomycetes* – Fungal classification – Fungal genera – Genetic markers – Habit and habitat – Hyphal system – Mycelium application – Saprobic fungi – White-rot

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Section 1: *Basidiomycota* genera entries

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Phylum *Basidiomycota* R.T. Moore
Class *Agaricomycetes* Doweld
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Agaricineae Fr.
Agaricaceae Chevall.

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Blumenavia Möller, Botanische Mitteilungen aus den Tropen 7, 57, 146 (1895) (Contributed by Sabin Khyaju)
Clathrus P. Micheli ex L., Species plantarum 2, 1179 (1753) (Contributed by Sabin Khyaju)

Colus Cavalier & Séchier, Annales des Sciences Naturelles, Botanique, Série 2, 3, 253 (1835) (Contributed by Sabin Khyaju)

Laternea Turpin, Cuvier, Dictionnaire des Sciences Naturelles 25, 248 (1822) (Contributed by Sabin Khyaju)

Ligiella J.A. Sáenz, Mycologia 72(2), 338 (1980) (Contributed by Sabin Khyaju)

Lysuraceae Corda

Lysurus Fr., Systema Mycologicum 2(2), 279, 285 (1823) (Contributed by Sabin Khyaju)

Phallaceae Corda

Echinophallus Henn., Botanische Jahrbücher für Systematik, Pflanzengeschichte und Pflanzengeographie 25, 505 (1898) (Contributed by Sabin Khyaju)

Endophallus M. Zang & R.H. Petersen, Mycologia 81(3), 488 (1989) (Contributed by Shiny Singh)

Mutinus Fr., Summa vegetabilium Scandinaviae, Sectio Posterior (Stockholm), 434 (1849) (Contributed by Arttapon Walker)

Phallus Junius ex L., Species plantarum 2, 1178 (1753) (Contributed by Sabin Khyaju)

Phallales genera incertae sedis

Endoclathrus B. Liu, Yin H. Liu & Z.J. Gu, Journal of Shanxi University, Natural Science 23(4), 345 (2000) (Contributed by Niranjan Mekala)

Neolysurus O.K. Mill., Ovrebo & Burk, Mycological Research 95(10), 1230 (1991) (Contributed by Niranjan Mekala)

Pseudoclathrus B. Liu & Y.S. Bau, Mycotaxon 10(2), 293 (1980) (Contributed by Sweta Rajput)

Cantharellales Gäum.

Aphelariaceae Corner

Aphelaria Corner, Monograph of *Clavaria* and allied Genera (Annals of Botany Memoirs No. 1), 180, 690 (1950) (Contributed by Sabin Khyaju)

Hydnaceae Chevall.

Burgella Diederich & Lawrey, Mycological Progress 6(2), 62 (2007) (Contributed by Niranjan Mekala)

Burgoa Goid., Bollettino della Regia Stazione di Patologia Vegetale, Roma, Nuova Serie 17, 354 (1937) (Contributed by Komal Verma)

Clavulina J. Schröt., Cohn, Kryptogamen-Flora von Schlesien 3.1(25–32), 442 (1888) (Contributed by Sabin Khyaju)

Corallofungus Kobayasi, Journal of Japanese Botany 58(6), 174 (1983) (Contributed by Sabin Khyaju)

Gloeomucro R.H. Petersen, Mycologia 72(2), 303 (1980) (Contributed by Komal Verma)

Membranomyces Jülich, Persoonia 8(3), 296 (1975) (Contributed by Shiny Singh)

Multiclavula R.H. Petersen, American Midland Naturalist 77, 207 (1967) (Contributed by Arttapon Walker)

Paullicorticium J. Erikss., Symbolae Botanicae Upsalienses 16(no. 1), 66 (1958) (Contributed by Manawaduge A. Madushani)

Repetobasidiellum J. Erikss. & Hjortstam, Eriksson, Hjortstam & Ryvarden, Corticiaceae of North Europe 6, 1247 (1981) (Contributed by Sabin Khyaju)

Rogersiomyces J.L. Crane & Schokn., American Journal of Botany 65, 903 (1978) (Contributed by Sabin Khyaju)

Scotomyces Jülich, Persoonia 10(1), 139 (1978) (Contributed by Sabin Khyaju)

Sistotremella Hjortstam, Eriksson, Hjortstam & Ryvarden, Corticiaceae of North Europe 7, 1379 (1988) (Contributed by Sweta Rajput)

Cantharellales genera incertae sedis

Ceratoporia Ryvarden & de Meijer, Synopsis Fungorum (Oslo) 15, 44 (2002) (Contributed by Sabin Khyaju)

Corticiales K.H. Larss.

Corticiaceae Herter

Erythricium J. Erikss. & Hjortstam, Svensk Botanisk Tidskrift 64(2), 165 (1970) (Contributed by Arttapon Walker)

Laetisaria Burds., Transactions of the British Mycological Society 72(3), 420 (1979) (Contributed by Shiny Singh)

Marchandiomyces Diederich & D. Hawksw., Diederich, Mycotaxon 37, 311 (1990) (Contributed by Niranjan Mekala)

Tretopileus B.O. Dodge, Bulletin of the Torrey Botanical Club 73, 223 (1946) (Contributed by Manawaduge A. Madushani)

Waitea Warcup & P.H.B. Talbot, Transactions of the British Mycological Society 45(4), 503 (1962) (Contributed by Komal Verma)

Corticiales genera incertae sedis

Corticirama Pilát, Beihefte zur Sydowia 1, 128 (1957) (Contributed by Sweta Rajput)

Gloeophyllales Thorn

Gloeophyllaceae Jülich

Chaetodermella Rauschert, Haussknechtia 4, 52 (1988) (Contributed by Sabin Khyaju)

Gloeophyllales genera incertae sedis

Campylomyces Nakasone, Sydowia 56(2), 261 (2004) (Contributed by Ishika Bera)

Pileodon P. Roberts & Hjortstam, Hjortstam, Roberts & Spooner, Kew Bulletin 53(4), 817 (1998) (Contributed by Sabin Khyaju)

Polyporales Gäum.

Adustoporiaceae Audet

Rhodonia Niemelä, Karstenia 45(2), 79 (2005) (Contributed by Ishika Bera)

Cerrenaceae Miettinen, Justo & Hibbett

Radulodon Ryvarden, Journal of Botany 50(10), 2073 (1972) (Contributed by Sabin Khyaju)

Irpicaceae Spirin & Zmitr.

Ceriporia Donk, Mededelingen van de Nederlandse Mycologische Vereeniging 2, 170 (1933) (Contributed by Didsanutda Gonkhom)

Irpex Fr., Systema Orbis Vegetabilis (Lundae), 81 (1825) (Contributed by Sabin Khyaju)

Laricifomitaceae Jülich

Ryvardenia Rajchenb., Nordic Journal of Botany 14(4), 436 (1994) (Contributed by Sabin Khyaju)

Meruliaceae Rea

Mycoacia Donk, Mededeelingen van de Nederlandsche Mycologische Vereeniging 18–20, 150 (1931) (Contributed by Sabin Khyaju)

Scopuloides (Massee) Höhn. & Litsch., Wiesner Festschrift (Wien), 57 (1908) (Contributed by Sweta Rajput)

Phanerochaetaceae Jülich

Porostereum Pilát, Bulletin Trimestriel de la Société Mycologique de France 52(3), 330 (1937) (Contributed by Sabin Khyaju)

Podoscyphaceae D.A. Reid

Podoscypha Pat., Essai Taxonomique sur les Hyménomycètes (Lons-le-Saunier), 70 (1900) (Contributed by Sweta Rajput)

Polyporaceae Fr. ex Corda

Favolus Fr., Elenchus Fungorum (Greifswald) 1, 44 (1828) (Contributed by Sabin Khyaju)

Lignosus Lloyd ex Torrend, Brotéria, Série Botânica 18(2), 121 (1920) (Contributed by Sabin Khyaju)

Phaeotrametes McGinty ex J.E. Wright, Mycologia 58(4), 529 (1966) (Contributed by Shiny Singh)

Podofomes Pouzar, Česká Mykologie 20(3), 174 (1966) (Contributed by Komal Verma)

Polyporus P. Micheli ex Adans., Familles des Plantes 2, 10 (1763) (Contributed by Sabin Khyaju)

Pseudofavolus Pat., Essai Taxonomique sur les Hyménomycètes (Lons-le-Saunier), 80 (1900) (Contributed by Ishika Bera)

Postiaceae B.K. Cui, Shun Liu & Y.C. Dai

Cyanosporus McGinty, Mycological Notes (Cincinnati) 33, 436 (1911) (Contributed by Didsanutda Gonkhom)

Pycnoporellaceae Audet

Crustoderma Parmasto, Conspectus Systematis Corticiacearum (Tartu), 87 (1968) (Contributed by Sweta Rajput)

Steccherinaceae Parmasto

Atraporiella Ryvarden, Synopsis Fungorum (Oslo) 23, 38 (2007) (Contributed by Niranjan Mekala)

Flaviporus Murrill, Bulletin of the Torrey Botanical Club 32(7), 360 (1905) (Contributed by Didsanutda Gonkhom)

Polyporales genera incertae sedis

Erythromyces Hjortstam & Ryvarden, Hjortstam & Tellería, Mycotaxon 37, 55 (1990) (Contributed by Niranjan Mekala)

Russulales Kreisel ex P.M. Kirk, P.F. Cannon & J.C. David

Bondarzewiaceae Kotl. & Pouzar

Amylaria Corner, Bulletin of the British Museum (Natural History), Botany 1(7), 197 (1955) (Contributed by Manawaduge A. Madushani)

Heterobasidion Bref., Untersuchungen aus dem Gesammtgebiete der Mykologie 8, 154 (1888) (Contributed by Arttapon Walker)

Laurilia Pouzar, Česká Mykologie 13(1), 14 (1959) (Contributed by Shiny Singh)

Steccherícium D.A. Reid, Kew Bulletin 17(2), 270 (1963) (Contributed by Sabin Khyaju)

Wrightoporia Pouzar, Česká Mykologie 20(3), 173 (1966) (Contributed by Shiny Singh)

Stereaceae Pilát

Acanthophysellum Parmasto, Eesti NSV Teaduste Akadeemia Toimetised, Seeria Bioloogia 16(4), 377 (1967) (Contributed by Arttapon Walker)

Thelephorales Corner ex Oberw.

Bankeraceae Donk

Hydnellum P. Karst., Meddelanden af Societas pro Fauna et Flora Fennica 5, 41 (1879) (Contributed by Lei Lei)

Agaricomycetes genera incertae sedis

Taiwanoporia T.T. Chang & W.N. Chou, Mycologia 95(6), 1215 (2003) (Contributed by Ishika Bera)

Section 2: Notes on terms related to mushroom mycelium-based biomaterials (Contributed by Sabin Khyaju)

3D-printing with mycelium
Acoustic insulation
Basidiomata
Beta-glucans
Biochar
Biodegradability
Biomaterial packaging
Biopolymer
Carbon footprint
Carbon sequestration
Chemical characterisation
Chitin
Circular economy
Compressive strength
Construction biomaterials
Denaturation
Dry density
Ectomycorrhizal fungi
Elastic modulus
Enzymatic degradation
Fire resistance
Flexural strength
Fourier Transform Infrared Spectroscopy
Genome editing
Impact strength
Lignocellulosic substrate
Load-bearing capability
Moisture content
Moulding
Mushroom mycelium
Mushroom mycelium inoculation
Mushroom mycelium-based biomaterials
Mushroom spawn
Mycelium anastomosis
Mycelium biocompatibility
Mycelium colonization
Mycelium fermentation

Mycelium growth kinetics
Mycelium living architecture
Mycelium-based leather
Porosity
Renewable materials
Saprophytic mushroom
Scaling up
Scanning Electron Microscopy
Soil enrichment
Sterilization
Sustainability
Tensile strength
Thermal insulation
Thermal pressing
Thermogravimetric analysis
Waste valorization
Water absorption rate
Water contact angle

Introduction

Fungalpedia is a comprehensive online database (www.fungalpedia.org) compiled by the Center of Excellence in Fungal Research, Mae Fah Luang University, Thailand, in collaboration with the Mushroom Research Foundation, developed from peer-reviewed literature. This platform serves as a one-stop resource for all the scattered mycological data into a systematic and accessible compilation of all fungal taxa and associated terminologies. The publications of Fungalpedia will be in series; each installment is dedicated to specific groups of fungi. The foundation of this platform was introduced by Hyde et al. (2023a), highlighting the theme and significance of Fungalpedia-related publications. Fungalpedia contributes to mycology by compiling and systematically presenting scattered information on fungal taxa into a common and accessible platform (Hyde et al. 2023a). This installment of the Fungalpedia series focuses on two distinct but interconnected areas of mycology, the taxonomy of fungal genera of *Basidiomycota* and the terminology of mushroom mycelium-based biomaterials. The first section provides detailed taxonomic notes on 226 genera. Each genus entry is a summary of original descriptions, current classification, and the latest nomenclatural placements. The entries also provide information on genus-specific genetic markers utilized for molecular identification and ecological information regarding habitat, host associations, and lifestyle. The redrawn illustrations for nearly all entries are to facilitate easy morphological identification. This section also provides an updated taxonomic framework for fungi enthusiasts by noting discrepancies in the major global fungal databases such as Species Fungorum, GenBank, MycoBank, and UNITE. Up-to-date fungal classification, based on an integrative approach of morphology, molecular, ecological and chemical evidence, helps solve scientific taxonomic placement (Hyde et al. 2023b). The second section of this study introduces the first formal compilation of 55 technical terms indispensable for the characterization and engineering of mycelium-based biomaterials. As the global demand for sustainable alternatives to plastics and foams grows, mycelium-based biomaterials have emerged as a primary focus of innovation. The mycelium-based biomaterials are sustainable materials developed using fungal mycelium and lignocellulosic substrates (Khyaju & Luangharn 2024). Notably, the choice of mushroom species has a pivotal role in determining the mechanical and overall properties of the final product. However, a systematic interface between classical mycological knowledge and materials has been conspicuously absent. The species descriptions incorporating morphological characteristics, phylogenetic relationships, cultivation parameters, wood decay mechanisms, and toxicological profiles enable systematic screening for mycelium-based biomaterial applications (Sydor et al. 2022, Khyaju et al. 2025a). Through this approach, this work helps to bridge that gap

by screening and selecting fungal species with optimal traits for the development of sustainable biomaterials.

Materials & Methods

A systematic approach was followed to compile descriptions and illustrations for both fungal genera and mycelium-based biomaterial terminologies. Relevant information for preparing entries was gathered from peer-reviewed articles, monographs, books, journals, and various online portals, including Google Scholar (https://scholar.google.com/), PubMed (https://pubmed.ncbi.nlm.nih.gov/), ScienceDirect (https://www.sciencedirect.com/), Elsevier (https://www.elsevier.com/), and Semantic Scholar (https://www.semanticscholar.org/). Data is cross-referenced with major repositories, such as Species Fungorum (https://www.indexfungorum.org/), MycoBank (https://www.mycobank.org/), GenBank (https://www.ncbi.nlm.nih.gov/), Facesoffungi (https://www.facesoffungi.org/), and UNITE (https://unite.ut.ee/index.php). In each genus entry, genetic markers, including internal transcribed spaces (ITS), large subunit of rRNA (LSU), small subunit of rRNA (SSU), RNA polymerase II largest subunit (*rpb1*), RNA polymerase II second largest subunit (*rpb2*), β-tubulin gene (*tub*), and α-translation elongation factor 1-alpha (*tef1-α*), used in the latest investigation on molecular phylogeny, are provided, except for the genera lacking molecular evidence. The taxonomic status of fungal taxa following the classification published by Hyde et al. (2024a) is provided. Nearly all 226 genera entries are accompanied by redrawn line drawings. These illustrations include morphological characters such as basidiospores, basidia, cystidia, and hyphal systems to assist in easy identification where molecular data might be unavailable. In the second section, standardized definitions of the terminologies related to mycelium-based biomaterials were selected based on the biomaterial development process, their relevance to material properties, and recurrent uses and are sourced from published and available research publications. All the notes are presented in alphabetical order in both sections. The original figures of basidiomata, equipment, and materials are used with permission from the authors.

Section 1: *Basidiomycota* genera entries

Phylum *Basidiomycota* R.T. Moore, Botanica Marina 23(6), 371

Species Fungorum, Facesoffungi, MycoBank, GenBank

Class *Agaricomycetes* Doweld, Prosyllabus Tracheophytorum, Tentamen Systematis Plantarum Vascularium (Tracheophyta) (Moscow), LXXVIII

Species Fungorum, Facesoffungi, MycoBank, GenBank

Agaricales Underw., Moulds, mildews and mushrooms. A guide to the systematic study of the Fungi and Mycetozoa and their literature (New York), 97

Species Fungorum, Facesoffungi, MycoBank, GenBank

Agaricineae Fr.

Species Fungorum, Facesoffungi, MycoBank, GenBank

Agaricaceae Chevall., Flore Générale des Environs de Paris 1, 121

Species Fungorum, Facesoffungi, MycoBank, GenBank

Classification: *Agaricineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Agaricaceae was established by F.F. Chevallier (1826), with *Agaricus* L. as the type genus, and includes diverse basidiomata forms, including agaricoid, secotioid, and gasteroid (Kooij et al. 2024). The recent outline of Fungi and fungus-like taxa has recognised approximately 54 genera and 2,235 species within this family (Hyde et al. 2024a). Members of this family are distributed

widely, forming a monophyletic group of saprotrophs and exhibiting a broad range of basidiospore colour (Vellinga 2004, Kooij et al. 2024). Kooij et al. (2024) followed and revised the classification of Singer (1986), dividing the *Agaricaceae* into tribes: *Agaricaceae*, *Coprineae* Kooij, *Cystolepioteae* Kooij, *Leucocoprineae*, *Lepioteae* Fayod ex Ulbr., *Lycoperdeae* Kooij, *Macrolepioteae* Kooij, and *Tulostomateae* Kooij. Members of this family are characterised by pluteoid, lepiotoid, or tricholomatoid basidiomata with free or rarely adnexed lamellae, the presence of a veil, hyaline to pigmented basidiospores, and a regular to subregular hymenophoral trama (Vellinga 2004, Nascimento & Alves 2014). Species belonging to *Agaricaceae* are distributed worldwide, including alpine, arctic, arid, temperate, and tropical regions (Vellinga 2004, Kooij et al. 2024). It includes edible, medicinal, and poisonous species (Nascimento & Alves 2014).

Dictyocephalos Underw. ex V.S. White, Bulletin of the Torrey Botanical Club 28, 441

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 1

Classification: *Agaricaceae, Agaricineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Dictyocephalos was established, with *D. attenuatus* as the type species (White 1901). The genus remained monotypic for more than a century, until the description of a second species, *D. xinjiangensis* (Dios et al. 2002, Hyde et al. 2021). Species of *Dictyocephalos* are found in soil and are distributed worldwide (Long & Plunkett 1940, He et al. 2019, Hyde et al. 2021). White (1901) reported specimens of *D. curvatus* Underw. (current name *D. attenuatus* (Peck) Long & Plunkett) being eaten by insects. To date, only two species are accepted worldwide (Hyde et al. 2024a).

Dictyocephalos is characterised by hypogeous basidiomata with a powdery cellular gleba, consisting of permanent cells, with dehiscence by irregular breaking away of the peridium, living persistent basidia and basidioles (White 1901, Long & Plunkett 1940, Hyde et al. 2021). The basidiomata are enclosed in a cup-like volva during the early stages, which is persistent at the base of the stipe (White 1901, Long & Plunkett 1940). The stipe is stout, solid, and becomes woody at maturity. The peridium is two-layered, comprising the outer roughened peridium and inner coriaceous to membranous endoperidium. The gleba is a powdery, mesh-like, irregular tissue, containing basidiospores and persistent fascicles of basidia (Long & Plunkett 1940). Basidiospores are globose to subglobose, verrucose, and fulvous (Long & Plunkett 1940, Hyde et al. 2021).

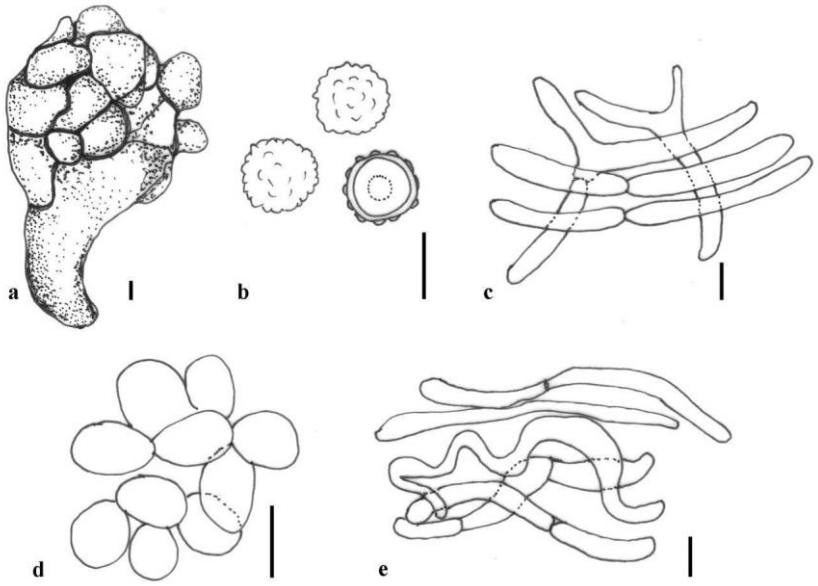


Fig. 1 – ***Dictyocephalos xinjiangensis*** (HMAS255794, holotype). a Basidiomata. b Basidiospores. c Exoperidial hyphae. d Group of globular elements. e Endoperidial hyphae. Scale bars: a = 1 cm,

b–d = 5 µm, e = 2 µm. Redrawn from Hyde et al. (2021). For original basidiomata, refer to Hyde et al. (2021).

Hyde et al. (2021) described a new species, *D. xinjiangensis*, based on a combination of morphological characteristics and phylogenetic analyses (ITS and LSU) of specimens collected in Xinjiang, China. *Dictyocephalos* is closely related to *Phellorinia* Berk., but is distinguished by the presence of thin, membranous plates in the gleba, which remain divided into compartments (Long & Plunkett 1940, Moreno et al. 1997, Dios et al. 2002). Additionally, the basidiomata of *Dictyocephalos* are generally larger and more robust than those of *Phellorinia* (Dios et al. 2002). The genus is classified in the same way in the 2024 Outline of Fungi and fungus-like taxa, Species Fungorum, MycoBank, GenBank, and UNITE.

Synonymy: *Battarreopsis* Henn., *Podoloma* Clem., *Whetstonia* Lloyd

Type species: *Dictyocephalos attenuatus* (Peck) Long & Plunkett

Basionym: *Battarrea attenuata* Peck

Other accepted species: *Dictyocephalos xinjiangensis* R.L. Zhao, M.Q. He & J. Xin Li

Melanophyllum Velen., České Houby (Praze) 3, 569

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 2

Classification: *Agaricaceae, Agaricineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota*, *Fungi*

Melanophyllum was described by Velenovský (1921) under *Agaricaceae*. The genus is characterised by small basidiomata having a convex-shaped pileus, turning black at maturity, gills covered with a membranous veil at early stages, remaining as patches or remnants on the edges for a few days, and black spore deposits. The stipe is smooth, thin, sinuous, and cartilaginous. Microscopically, it is distinguished by its pale to translucent yellow basidiospores and absence of cheilocystidia (Velenovsky 1921). However, Vellinga (2003) has mentioned the genus with a pileus covering composed of globose cells and spores with persistent green colour and rough, warted ornamentation (Velenovsky 1921). *Melanophyllum* was found to be growing on bare moist ground in old oak woods (Velenovsky 1921).

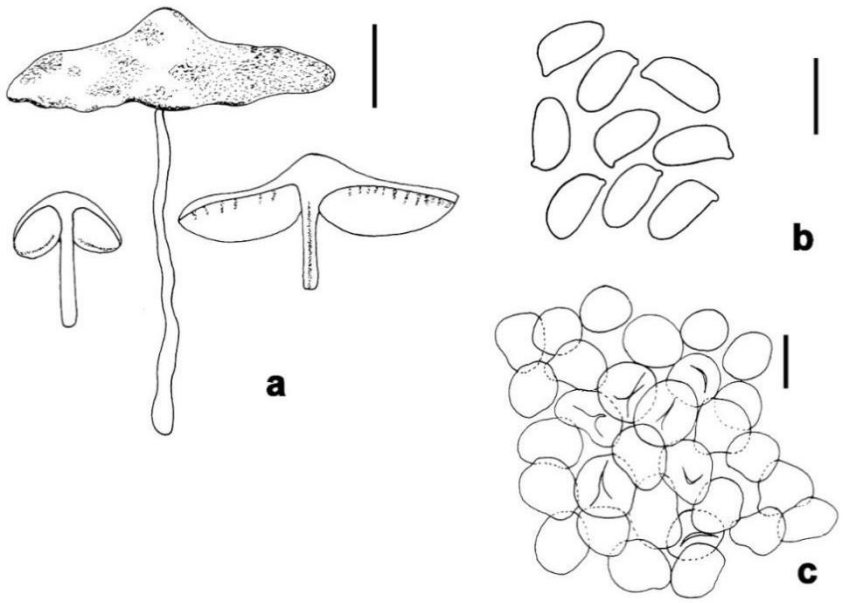


Fig. 2 – ***Melanophyllum canali*** (holotype). a Basidiomata. b Basidiospores. c Elements of pileipellis. Scale bars: a = 1 cm, b = 10 µm, c = 40 µm. Redrawn from Velenovsky (1921) and Munoz (2021).

Melanophyllum comprises four species (Qu et al. 2023, Hyde et al. 2024a). The specific epithet of the type species, *Melanophyllum canali*, was given "in the memory of Count Canala de Malabaila, a passionate supporter of botanists" (Velenovsky 1921). Phylogenetic studies based on ITS and LSU data of various genera in *Agaricaceae* showed that *Melanophyllum* belongs to the clade of *Lepiota* and forms monophyly with *Cystolepiota* Singer, *Echinoderma* (Locq. ex Bon) Bon, and *Pulverolepiota* Bon (Vellinga 2004). Further, a phylogenetic study showed the monophyly of *Smithiomyces* and a close evolutionary relationship with the non-monophyletic genera *Melanophyllum* and *Cystolepiota*. As *Melanophyllum* is underexplored, further investigation needs to be undertaken to obtain a better understanding of species diversity and the systematic position of the species (Qu et al. 2023). The genus is classified in the same way in the 2024 Outline of Fungi and fungus-like taxa, Species Fungorum, MycoBank, GenBank, and UNITE.

Synonym: *Chlorosperma* Murrill, *Chlorospora* Massee, *Glaucospora* Rea

Type species: *Melanophyllum canali* Velen. (≡*Melanophyllum haematospermum*) (Bull.) Kreisel

Other accepted species:

M. collariatum Velen.
M. eyrei (Massee) Singer
M. globisporum T.J. Baroni

Smithiomyces Singer, Mycologia 36(4), 366

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 3

Classification: *Agaricaceae, Agaricineae*, *Agaricales, Agaricomycetes, Agaricomycotina*, *Basidiomycota*, *Fungi*

Smithiomyces was established by Singer (1944) to include *Leucomyces mexicanus* Murrill, which had also previously been classified under the genera *Amanita* Pers. and *Venenarius* Earle. The presence of a heteromerous character of the fragmentary veil on the pileus surface makes this species unique and differentiates it from its former genera (Singer 1944). Currently, the accepted name of this species is *Smithiomyces mexicanus* (Murrill) Singer, and it is also the type species of the genus.

The name *Smithiomyces* was established in honour of the distinguished American mycologist Alexander H. Smith (Singer 1944). Singer characterized this monotypic genus based on morphological and anatomical features of its type species. *Smithiomyces mexicanus* is a lepiotoid species discovered from the tropical region of Mexico (Justo et al. 2015). This species is identified by its white basidiomata, fragmentary remnants of the veil on pileus and stipe, presence of globose structures in the pileus covering, rough-surfaced, non-dextrinoid, and non-metachromatic basidiospores, and presence of clamp connections (Singer 1944, Horak 1968, Vellinga 1999). A second species, *Lepiota lanosofarinosa* Rick (≡*Smithiomyces lanosofarinosus* (Rick) Raithelh.) originally reported from Brazil was transferred to *Smithiomyces* (Raithelhuber 1988). Four species, *S. dominicanus* Justo, Angelini & Bizzi from the Dominican Republic, *S. asiaticus* Z.W. Ge & H. Qu, *S. heterosporus* Z.W. Ge & H. Qu, and *S. lepiotoides* Z.W. Ge & H. Qu from China were added (Justo et al. 2015, Ge et al. 2021).

The habitat of *Smithiomyces* is mostly tropical. The discovery of its species in China has revealed that the genus is native to regions spanning from the Neotropics to tropical Asia (Ge et al. 2021). Additionally, the monophyletic nature of *Smithiomyces* and its affinity towards *Melanophyllum* Velen. and *Cystolepiota* Singer in *Agaricaceae* Chevall. have also been confirmed based on molecular studies (Ge et al. 2021). Hyde et al. (2024a) and Species Fungorum (2026) lists six species under *Smithiomyces* worldwide. The genus is classified in the same way in the 2024 Outline of Fungi and fungus-like taxa, Species Fungorum, MycoBank, GenBank, and UNITE.

Type species: *Smithiomyces mexicanus* (Murrill) Singer

Basionym: *Leucomyces mexicanus* Murrill

Other species:

S. asiaticus Z.W. Ge & H. Qu

S. dominicanus Justo, Angelini & Bizzi
S. heterosporus Z.W. Ge & H. Qu
S. lanosofarinosus (Rick) Raithelh.
S. lepiotoides Z.W. Ge & H. Qu

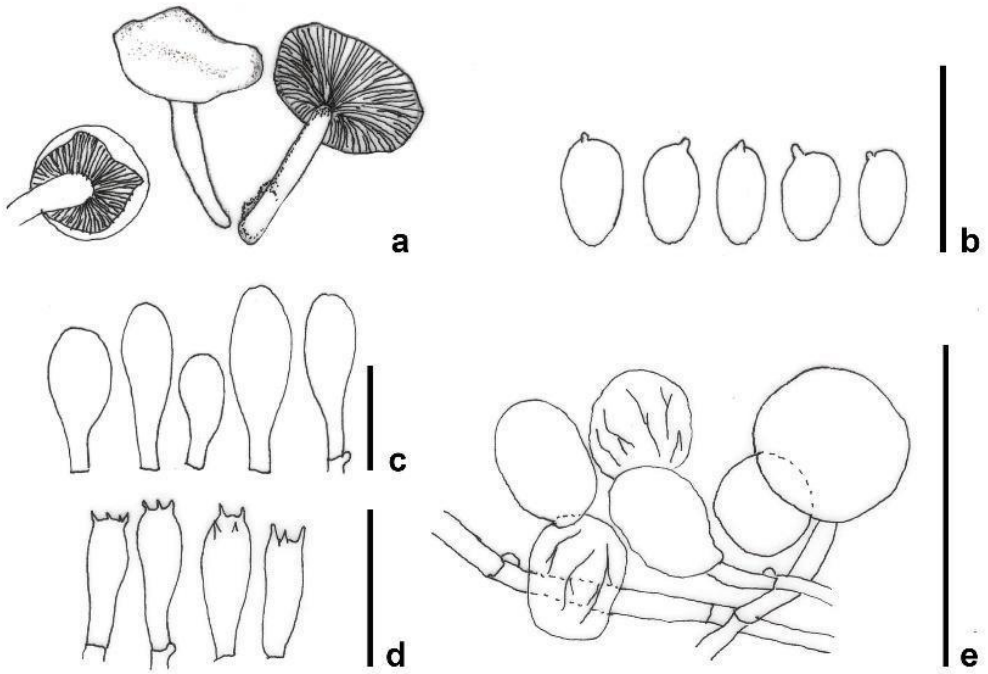


Fig. 3 – ***Smithiomyces dominicanus***. a Basidiomata. b Basidiospores. c Cheilocystidia. d Basidia. e Pileus covering. Scale bars: b = 10 μm; c–d = 20 μm; e = 100 μm. Redrawn from Justo et al. (2015).

Crepidotaceae (S. Imai) Singer, Lilloa 22: 584

Species Fungorum, Facesoffungi, MycoBank, GenBank

Classification: *Agaricineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Crepidotaceae was established by R. Singer with the type genus *Crepidotus* (Fr.) Staude (Singer 1951). Initially, Imai (1938) erected the monogeneric tribe *Crepidoteae* S. Imai to accommodate eccentric, lateral, or sessile agaric species with subdecurrent lamellae and ocherous or gerruginous basidiospores. Aime et al. (2005) conducted a molecular analysis (LSU) of the agaric genera in this family to revise their traditional morphology-based classification, including genera from Singer (1986). Currently, the *Crepidotaceae* includes seven genera, *Crepidotus* (Fr.) Staude, *Episphaeria* Donk, *Nanstelocephala* Oberw. & R.H. Petersen, *Neopaxillus* Singer, *Pellidiscus* Donk, *Pleuroflammula* Singer, and *Simocybe* P. Karst. (He et al. 2019, Hyde et al. 2024a). Species under *Crepidotaceae* are distinguished by basidiospores either an ornamented or irregular outline, thick-walled, and a darker spore print (Petersen et al. 2010). Members of *Crepidotaceae* are saprotrophic and are distributed worldwide (Aime et al. 2005).

Nanstelocephala Oberw. & R.H. Petersen, Oberwinkler, Petersen & Bandoni, Mycologia 82(6), 783

Species Fungorum, Facesoffungi, MycoBank Fig. 4

Classification: *Crepidotaceae, Agaricineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Nanstelocephala is a monotypic genus established by F. Oberwinkler, R.H. Peterson, and R.J. Bandoni (Oberwinkler et al. 1990, Hyde et al. 2024a). The genus name is derived from Greek, with

nanos meaning 'dwarf', *stele* meaning 'stalk', and *kephalos* meaning 'head'. The type species, *N. physalacrioides*, was collected on an unidentified fallen dead branch in North Carolina, USA. This species is saprobic and known only from the USA (Oberwinkler et al. 1990). Notably, the International Code of Nomenclature for algae, fungi, and plants has included this genus in the list of protected generic names for fungi (Kirk et al. 2013).

Nanstelocephala is characterised by its small, stalked-capitate basidiomata, which are white to cream, soft when fresh and become ochraceous and horny upon drying (Oberwinkler et al. 1990). Microscopically, the basidiospores are subglobose to ellipsoid, thick-walled, and warty, initially yellow to ochraceous in colour before maturity to brown. Basidia are clavate, apically swollen, and 4-spored. Cystidia are absent, while hyphidia are abundant, irregularly bent, thin-walled, and hyaline. The hyphal system is monomitic, smooth, thin-walled, and densely packed with hyphae (Oberwinkler et al. 1990).

Species delineation of *Nanstelocephala* from other genera is solely based on macro- and micro-morphology due to the lack of molecular sequences (He et al. 2019). *Nanstelocephala* is closely related to *Pellidiscus* Donk, with similar basidiospores, basidia, and hyphae (Oberwinkler et al. 1990). However, *Pellidiscus* is distinct by its loose hyphal context (Donk 1959, Oberwinkler et al. 1990). In addition, *Nanstelocephala* exhibits morphological resemblance to *Physalacria* Peck, but the latter has smooth and hyaline basidiospores and the presence of oleocystidia (Berthier 1985, Oberwinkler et al. 1990). The taxonomic classification of *Nanstelocephala* is under *Crepidotaceae* in Species Fungorum, MycoBank, and Hyde et al. (2024a); however, UNITE has placed it under *Cortinariaceae* and may require updating.

Type species: *Nanstelocephala physalacrioides* Oberw. & R.H. Petersen

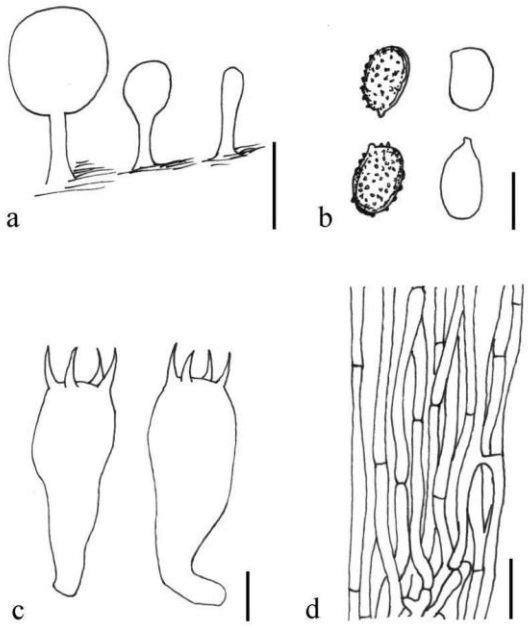


Fig. 4 – ***Nanstelocephala physalacrioides***. a Basidiomata. b Basidiospores. c Basidia. d Hyphal arrangement of the stalk. Scale bar: a = 200 µm, b–c = 5 µm, d = 10 µm. Redrawn from Oberwinkler et al. (1990). For original basidiomata, refer to GBIF (2025).

Pleuroflammula Singer, in Singer & Smith, Mycologia 38(5), 521

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 5

Classification: *Crepidotaceae, Agaricineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Pleuroflammula was established by R. Singer, with its type species *P. dussii* (Singer 1946). *Pleuroflammula dussii* was originally described as *Crepidotus dussii* Pat., based on specimens collected from rotten wood in Guadeloupe, France (Patouillard 1902). *Pleuroflammula* differs from

Flammula (Fr.) P. Kumm. in its highly eccentric pileus, lateral stipe, or subsessile nature (Singer 1946). Species of *Pleuroflammula* are either solitary or gregarious and are found in tropical, subtropical, and temperate regions across both hemispheres (Horak 1978, Crous et al. 2021).

Species of *Pleuroflammula* are characterised by scaly, squamulose or squarrulose basidiomata, with a floccose-crenate to appendiculate margin formed from veil remnants. The stipe is squamulose below a sub-membranaceous or peronate annulus. Basidiospores are broadly ovate, smooth, thick-walled, rust-brown to yellow-brown and lack germ pores. The basidia are typically 4-spored, rarely 2-spored. Chielocystidia are hyaline, clavate, rarely cylindrical or tapering towards the apex, and lack crystals. Notably, the yellow encrusting pigment in the basidiomata dissolves immediately when exposed to 3% KOH (Horak 1978).

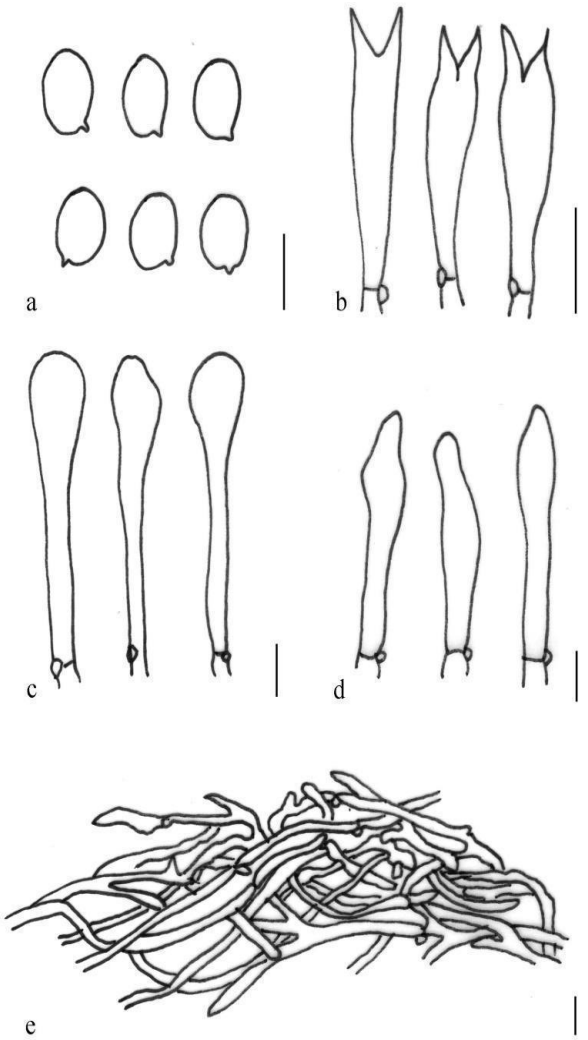


Fig. 5 – ***Pleuroflammula ragazziana***. a Basidiospores. b Basidia. c Cheilocystidia. d Pleurocystidia. e. Pileipellis. Scale bar: a−e = 10 µm. Redrawn from Giercyzk & Kubinski (2019). For original basidiomata, refer to Geercyzk & Kubinski (2019).

Pleuroflammula is morphologically similar to *Crepidotus* (Fr.) Staude, *Phaeomarasmius* Scherff., *Pholiota* (Fr.) P. Kumm., and *Simocybe* P. Karst. (Horak 1978, 2018, Crous et al. 2021). However, it is distinct from *Crepidotus* by the absence of a veil (Horak 1978). *Pleuroflammula* is distinguished from *Phaeomarasmius* by its KOH-soluble pigment, non-encrusted cheilocystidia, and smaller basidiospores (Crous et al. 2021).

Crous et al. (2021) described a new species, *P. pannonica* Polhorský, Kautmanová & Szabóová, based on specimens collected from fallen dead branches of *Quercus* sp., using

morphological characteristics and phylogenetic analysis (ITS and LSU). Species Fungorum (2026) lists 24 species of *Pleuroflammula* worldwide. The classification of *Pleuroflammula* in *Crepidotaceae* is in agreement in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Type species: *Pleuroflammula dussii* (Pat.) Singer

Basionym: *Crepidotus dussii* Pat.

Other accepted species: (Species Fungorum – search *Pleuroflammula*)

Hydnangiaceae Gäum. & C.W. Dodge, Comparative Morphology of Fungi (London), 485

Species Fungorum, Facesoffungi, MycoBank, GenBank

Classification: *Agaricineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Hydnangiaceae was established by E.A. Gäum. and C.W. Dodge in 1928 with *Hydnangium* Wallr. as the type genus (Gäumann & Dodge 1928). The family consists of four genera: *Hydnangium*, *Laccaria* Berk. & Broome, *Maccagnia* Mattir., and *Podohydnangium* G.W. Beaton, Pegler & T.W.K. Young (He et al. 2019, Hyde et al. 2024a). *Hydnangiaceae* accommodates approximately 114 recognised species distributed worldwide and are ectomycorrhizal with several hosts, including *Betulaceae*, *Dipterocarpaceae*, *Fagaceae*, *Myrtaceae*, *Pinaceae*, *Salicaceae*, and *Tiliaceae* (Ramos et al. 2017, Hyde et al. 2024a, Thapa et al. 2024a). Some species, such as *L. amethystina* Cooke, *L. aurantia* Popa, Rexer, Donges, Zhu L. Yang & G. Kost, *L. bicolor* (Maire) P.D. Orton, *L. moshuijun* Popa & Zhu L. Yang, *L. vinaceoavellanea* Hongo, are edible and widely consumed (Wu et al. 2019a, Zhang et al. 2023, Thapa et al. 2024a). Ecologically, some *Laccaria* species grow in heavy metal-polluted areas and play a key role in the ecological progression of forest ecosystems (Zhang et al. 2023, Thapa et al. 2024a).

Maccagnia Mattir., Atti della Reale Accademia Nazionale dei Lincei, Memorie della Classe di Scienze Fisiche Matematiche e Naturali, Serie 5, 13, 537

Species Fungorum, Facesoffungi, MycoBank

Classification: *Hydnangiaceae*, *Agaricineae*, *Agaricales*, *Agaricomycetes*, *Agaricomycotina*, *Basidiomycota*, *Fungi*

Maccagnia is a monotypic gasteroid genus erected by Mattirolo in 1922 (Dodge & Zeller 1936, Hyde et al. 2024a). The only known species and generic type is *Maccagnia carnica* Mattirolo, collected in Italy (Singer 1959a).

Maccagnia is morphologically characterised by small, spherical fructifications that dry hard and horny, a highly developed columella, and abundant lactiferous ducts (Dodge & Zeller 1936). The cavities are filled with small hyaline, thick-walled basidiospores on zig-zag hyphae, which soon form a gel where the basidia and basidiospores are later borne (Dodge & Zeller 1936). These basidiospores are subglobose to short-ellipsoid, oblong, or spherical and vaguely angular in polar view (Singer 1959a). They are rather small and echinate, with a thick epispore (Dodge & Zeller 1936). The hilar appendage is symmetrically attached or slightly off-centre. These basidiospores are hyaline to pale honey-colored, with fine spinules or low warts that give them a rough texture under oil immersion. Their ornamentation is non-amyloid and resembles that found in *Lepista* (Fr.) Sm. (Singer 1959a). The basidia are clavate and bear four slender, straight sterigmata. There are no cystidia or pseudocystidia. The subhymenium lacks cellular differentiation, while the hymenophoral trama is composed of interwoven filamentous hyphae, some of which are swollen. These elements are mostly hyaline, with some exhibiting a honey-colored pigment. Unlike *Russulaceae* Lotsy, or *Arcangeliella* Cavara, the oleiferous hyphae do not contain true oleiferous or laticiferous structures but may turn greenish in iodine (Singer 1959a). The peridium consists of tangentially arranged filamentous hyphae interwoven with spherocyst-like elements, but does not exhibit the heteromerous structure seen in *Russula* Pers.. The columella is composed of interwoven filamentous and spherocyst-like hyphae, appearing denser rather than distinctly gelatinous. Clamp connections are present, and none of the hyphal structures exhibits amyloid or amylaceous

properties (Singer 1959a). *Maccagnia* appears intermediate between *Sclerogaster* Hesse, *Leucogaster*, and *Arcangeliella*, having the spores and texture of a *Sclerogaster*, the general ontogeny of a *Leucogaster*, and the columella and lactiferous ducts of an *Arcangeliella* (Dodge & Zeller 1936). The classification of *Maccagnia* in *Hydnangiaceae* is in agreement in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Type species: *Maccagnia carnica* Mattir.

Podohydnangium G.W. Beaton, Pegler & T.W.K. Young, Kew Bulletin 39(4), 506

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 6

Classification: *Hydnangiaceae, Agaricineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Podohydnangium is a monotypic gasteroid genus established by G.W. Beaton, Pegler & T.W.K. Young, with *P. australe* as the type species (Beaton et al. 1984, Hyde et al. 2024a). The type specimen of *Podohydnangium* was collected under litter in a wet *Eucalyptus* forest in Victoria, Australia (Beaton et al. 1984). The basidiomata are subepigeal, hemiangiocarpic, small, globose to turbinate or stipitate, with gleba progressively exposed towards the base. The peridium is very thin, membranous, and pale, eventually flakes away. Gleba is concolourous, non-gelatinised, and consists of radially arranged chambers. Chambers are small, irregular, anastomosing, and hollow. Columella is present, ranging from partially to completely percurrent. Hymenophoral trama are regular and hyaline. Peridiopellis is composed of undifferentiated, agglutinated hyphae. Basidia are elongated and bear 2 or 4 sterigmata. Spore deposit is white to cream. Basidiospores are orthotropic, statismosporic, globose, hyaline, inamyloid, and non-dextrinoid, with crowded and hyaline spine ornamentation. Clamp connections are present in all hyphae (Beaton et al. 1984).

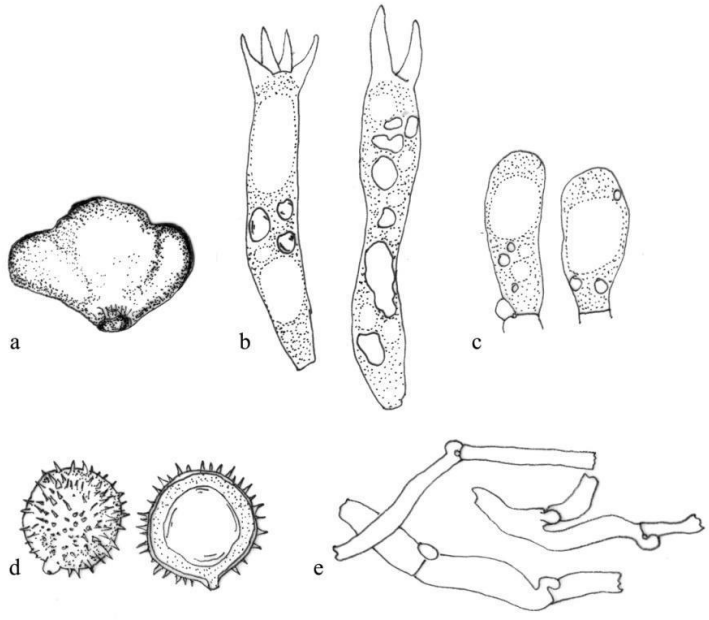


Fig. 6 – ***Podohydnangium australe*** (Beaton 48). a Basidiomata, ×1. b Basidia, ×1000. c Basidioles, ×1000. d Basidiospores, ×1750. e Glebal hyphae, ×500. Redrawn from Beaton et al. (1984).

Both morphological and phylogenetic analyses (ITS, *rpb2,* and *tef-1α*) have been employed to delimit *Podohydnangium* species and *Hydnangium* and *Laccaria* (Sheedy et al. 2013). *Podohydnangium* is an intermediate genus between the agaricoid genus *Laccaria* Berk. & Broome (*Tricholomataceae*) and the gasteroid genus *Hydnangium* Wallr. (Beaton et al. 1984). The basidiomata of *Hydnangium* (hypogeous or subepigeous, angiocarpous, truffle-like) and *Laccaria* (epigeous, hemiangiocarpous, agaricoid) differ from those of *Podohydnangium* (Beaton et al. 1984,

Bougher et al. 1993). *Podohydnangium* differs from *Laccaria* in its lack of lamellate hymenophore and poorly developed stipe (Beaton et al. 1984). Basidiospores are forcibly ejected in *Laccaria*, a feature absent in the other two genera (Bougher et al. 1993). The classification of *Podohydnangium* in *Hydnangiaceae* is in agreement in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Type species: *Podohydnangium australe* G.W. Beaton, Pegler & T.W.K. Young

Hymenogastraceae Vittad., Monographia Tuberacearum (Milano), 11

Species Fungorum, Facesoffungi, MycoBank, GenBank

Classification: *Agaricineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Hymenogastraceae was established by C. Vittadini in 1831, with *Hymenogaster* Vittad. as the type genus (Vittadini 1831). The family members are distributed worldwide and consist of 12 genera: *Anamika* K.A. Thomas, Peintner, M.M. Moser & Manim., *Chromocyphella* De Toni & Levi, *Flammula* (Fr.). P. Kumm., *Galerina* Earle, *Gymnopilus* P. Karst., *Hebeloma* (Fr.) P. Kumm., *Hymenogaster* Vittad., *Naucoria* (Fr.) P. Kumm., *Phaeocollybia* R. Heim, *Psathyloma* Soop, J.A. Cooper & Dima, *Psilocybe* (Fr.) P. Kumm., and *Synnematomyces* Kobayasi (Hyde et al. 2024a). *Hymenogastraceae* is characterised by gilled or truffle-like basidiomata and is either ectomycorrhizal or saprotrophic (He et al. 2019). The hallucinogenic mushrooms in the genus *Psilocybe* produce bioactive compounds (psilocybin) while *Galerina* contains toxins (amatoxins) (He et al. 2019).

Hymenogaster Vittad., Monographia Tuberacearum (Milano), 30

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 7

Classification: *Hymenogastraceae, Agaricineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Hymenogaster was introduced by Carlo Vittadini (Vittadini 1831), and the type species is *H. citrinus* (Dodge & Zeller 1934). Interestingly, this genus contains the most species among false truffles (Pegler et al. 1993, Montecchi & Sarasini 2000, Stielow et al. 2011), and is also considered an ectomycorrhiza which can live with a vast group of plants such as *Betulaceae*, *Ericaceae*, *Fagaceae*, *Myrtaceae*, *Pinaceae*, *Salicaceae*, and *Tiliaceae*. As they are mycorrhiza, they act as an important component for nutrient uptake for plants and other roles in ecosystems (Trappe et al. 2009, Turkoglu & Castellano 2013, Pecoraro et al. 2017, Rudawska et al. 2019).

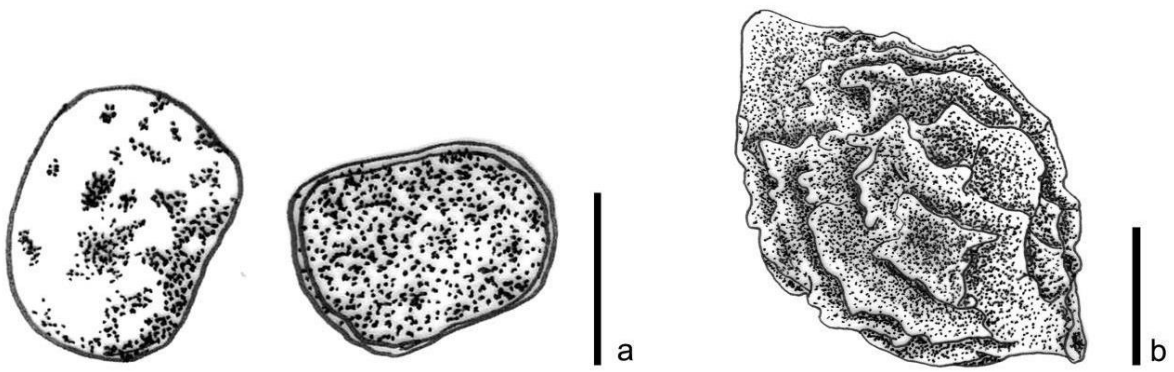


Fig. 7 – ***Hymenogaster papilliformis*** (BJTC FAN1074, holotype). a Basidiomata. b Basidiospore. Scale bar: a = 2 cm, b = 5 μm. Redrawn from Li et al. (2024a).

Smith et al. (2018) summarised several reports of *Hymenogaster* from different parts of the world, including Asia, Europe, Australia, and North America. Still, many species were not included in the same lineage as the type species. It should be noted that morphological identification of this genus has resulted in ongoing taxonomic uncertainty and errors (Dodge & Zeller 1934, Soehner 1962, Bougher & Castellano 1993). The colour or discolouration of the basidiomata and the shape, colour, and ornamentation of basidiospores are the characteristics used to identify different species (Li et al. 2024a). Based on literature searches, there was a report using the ITS gene (Stielow et al. 2011) and a few reports using multiple genes (Smith et al. 2018, Li et al. 2024a). The taxonomic classification of *Hymenogaster* is placed under *Hymenogastraceae* in Species Fungorum, GenBank, UNITE, and Hyde et al. (2024a); however, MycoBank places it under *Strophariaceae* and it may require an update. Under *Hymenogaster*, Species Fungorum (2026) lists 92 species worldwide.

Synonymy: *Dendrogaster* Bucholtz, *Fechtneria* Velen., *Hysterogaster* C.W. Dodge, *Rhizopogoniella* Soehner

Type species: *Hymenogaster citrinus* Vittad.

Other accepted species: (Species Fungorum – search *Hymenogaster*)

Inocybaceae Jülich, Bibliotheca Mycologica 85, 374

Species Fungorum, Facesoffungi, MycoBank, GenBank

Classification: *Agaricineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Inocybaceae was established by W. Jülich in 1982 with the type species *Inocybe* (Fr.) Fr. (Jülich 1982). *Inocybaceae* consists of 1,050 recognised species divided into seven genera: *Auritella* Matheny & Bougher, *Inosperma* (Kühner) Matheny & Esteve-Rav., *Inocybe*, *Mallocybe* (Kuyper) Matheny, Vizzini & Esteve-Rav., *Nothocybe* Matheny & K.P.D. Latha, *Pseudosperma* Matheny & Esteve-Rav., and *Tubariomyces* Esteve-Rav. & Matheny (Matheny & Kudzma 2019, Cho et al. 2021). Species in this family form ectomycorrhizal associations with around 23 families of vascular plants, including *Betulaceae*, *Dipterocarpaceae*, *Fagaceae*, *Pinaceae*, and *Salicaceae*. Members of the family *Inocybaceae* are poisonous mushrooms that contain secondary metabolites, including muscarin and psilocybin (Cho et al. 2021).

Auritella Matheny & Bougher, Mycotaxon 97, 232

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 8

Classification: *Inocybaceae*, *Agaricineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Auritella was proposed by Matheny & Bougher (2006) to represent a distinct lineage within *Inocybaceae* Jülich. This genus is a heterogeneous group comprising species found primarily in Africa and Australia (Matheny & Bougher 2006). Species of *Auritella* are characterised by tough agaricoid basidiomata with a squarrose, squamulose, or tomentose pileus, long cheilocystidia, and the absence of pleurocystidia. They also feature necropigmented basidia and basidiospores that are smooth, brownish to ochraceous-buff, with an indistinct or rarely distinct apiculus (Matheny & Bougher 2006). Phylogenetic studies have positioned *Auritella* as a sister group to *Mallocybe* (Kuyper) Matheny, Vizzini & Esteve-Rav., with most species originating in the Southern Hemisphere (Matheny & Bougher 2006). Additionally, the phylogenetic framework supporting *Auritella* includes clock phylogeny analysis, which helps to provide a stable key for distinguishing species within the genus (Matheny & Bougher 2006, Matheny et al. 2017).

Matheny et al. (2012) described a new species from the tropical evergreen forests of India. This species is notable for its thick-walled cheilocystidia and its placement within a sister clade to existing *Auritella* species in phylogenetic analyses (Matheny et al. 2012). Further research in 2017 led to the description of two additional species, again supported by both morphological characteristics and phylogenetic data (Matheny et al. 2017). Species Fungorum (2025) lists 20 records of *Auritella,* but Wijayawardene et al. (2022) recognised only eight species worldwide. These species are distributed across Australia, Cameroon, Gabon, India, and the USA (Matheny &

Bougher 2006, Matheny et al. 2012, Matheny et al. 2017). *Auritella* species are typically found growing in association with specific tree hosts, including *Gilbertiodendron dewevrei*, *Uapaca* species, *Dipterocarpaceae* (*Dipterocarpus indicus*), *Xanthophyllaceae* (*Xanthophyllum arnottianum*), *Myrtaceae*, and *Fabaceae* (Matheny & Bougher 2006, Matheny et al. 2012, Matheny et al. 2017). Phylogenetic trees constructed for *Auritella* are based on ribosomal (LSU) and protein-coding (*rpb2*) genes (NCBI 2025), which have provided robust support for the classification of species within the genus (Matheny & Bougher 2006, Matheny et al. 2012, Matheny et al. 2017). The classification of *Auritella* in *Inocybaceae* is in agreement in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a). Under *Auritella*, Hyde et al. (2024a) and Species Fungorum (2026) recognise 13 species worldwide.

Type species: *Auritella dolichocystis* Matheny, Trappe & Bougher

Other accepted species: (Species Fungorum – search *Auritella*)



Fig. 8 – ***Auritella foveota*** (TENN 063905, holotype). a–c Basidiomata. d Basidiospores. e Basidia. f Cheilocystidia. g Terminal elements of the pileipellis. h Caulocystidia. Scale bars: c = 1 cm, d–h = 10 µm. Redrawn from Matheny et al. (2012). Photo credit: Matheny et al. (2012).

Lycoperdaceae Bercht. & J. Presl, O Přirozenosti Rostlin (Aneb Rostlinář) 1, 273

Species Fungorum, Facesoffungi, MycoBank, GenBank

Classification: *Agaricineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota,*

Fungi

Lycoperdaceae was established by F. Berchtold and J.S. Presl with *Lycoperdon* Pers. as the type genus (Berchtold & Presl 1820). The family consists of 13 genera: *Abstoma* G. Cunn., *Acutocapillitium* P. Ponce de León, *Apioperdon* (Kreisel & D. Krüger) Vizzini, *Arachnion* Schwein., *Bovista* Pers., *Bryoperdon* Vizzini, *Calbovista* Morse ex M.T. Seidl, *Calvatia* Fr., *Disciseda* Czern., *Gastropila* Homrich & J.E. Wright, *Lycoperdon*, *Lycoperdopsis* Henn., and *Morganella* Zeller (Hyde et al. 2024a). However, a recent comprehensive study by Yang et al. (2025) divided the family into 19 genera, based on morphological characteristics, phylogenetic analyses (ITS+LSU+*rpb2*+*tef1*-*α*), and divergence-time analyses. *Lycoperdaceae*, commonly known as puffballs, is characterised by globose to subglobose basidiomata, with mature gleba and releasing a powdery mass of basidiospores passively through the apical opening of the endoperidium (Krüger et al. 2001, Yang et al. 2025). Members of *Lycoperdaceae* are distributed worldwide, found on the forest floor, decaying wood, or meadows (Pegler et al. 1995, Yang et al. 2025). Some species are used in culinary and medicinal purposes, including *Calvatia craniiformis* (Schwein.) Fr. ex De Toni and *C. cyathiformis* (Bosc) Morgan (Yang et al. 2025).

Gastropila Homrich & J.E. Wright, Mycologia 65(4), 780

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 9

Classification: *Lycoperdaceae, Agaricineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Gastropila, established by Homrich and J. E. Wright in 1973, was originally classified as *Pila* Speg. (Homrich & Wright 1973). The type species, *G. fragilis*, was described based on a specimen collected on soil in Uruguay. Later, Ponce de Leon (1976) described three new species, *G. fumosa*, *G. hesperia*, and *G. subcretacea*. These species are found solitary or gregarious in soil, typically among grasses or under spruce and fir trees (Ponce de Leon 1976). Members of *Gastropila* are globally distributed, mainly in Asia, Europe, and North and South America, though they are considered rare (Rebriev & Assyov 2012, He et al. 2019).

Gastropila species are characterised by globose basidiomata with irregular apical openings that form radiate-stellate structures (Diego Calonge & Martin 1990). The peridium is thick, smooth, sparsely branched, and externally fragile but corky-spongy internally (Homrich & Wright 1973, Diego Calonge & Martin 1990). It is composed of three layers: a very thin outer layer, a fragile middle layer, and an extremely thick and fragile inner layer (Homrich & Wright 1973). The subgleba is absent in this genus. Basidiospores are small, smooth, and ovoid (Diego Calonge & Martin 1990). The capillitium consists of smooth, sparsely branched threads that are highly entangled but not easily broken (Homrich & Wright 1973).

In the delineation of *Gastropila* species, only macro- and micro-morphological characteristics have been documented, as molecular data are currently unavailable (He et al. 2019). Although members of *Gastropila* are morphologically similar, the exoperidium in *G. fragilis*, *G. fumosa*, and *G. hesperia* is smooth, while in *G. subcretacea* it is covered with polygonal warts (Ponce de Leon 1976). The capillitium in *G. fragilis* contains round pits, whereas *G. fumosa* and *G. hesperia* feature pit-like structures. Basidiospores in *G. fumosa* are echinate, while those in *G. hesperia* are smooth (Ponce de Leon 1976). *Gastropila* shares similarities with *Calvatia,* but it differs in spore morphology and the presence or absence of the subgleba (Diego Calonge & Martin 1990). The taxonomic classification of *Gastropila* is placed under *Lycoperdaceae* in Species Fungorum, GenBank, and Hyde et al. (2024a); however, MycoBank and UNITE place it under *Agaricaceae* and it may require an update. Under *Gastropila*, Hyde et al. (2024a) and Species Fungorum (2026) recognise 3 species worldwide.

Synonymy: *Pila* Speg.

Type species: *Gastropila fragilis* (Lév.) Homrich & J.E. Wright

Basionym: *Mycenastrum fragile* Lév.

Other accepted species:

G. fumosa (Zeller) P. Ponce de León

G. hesperia (Morgan) P. Ponce de León

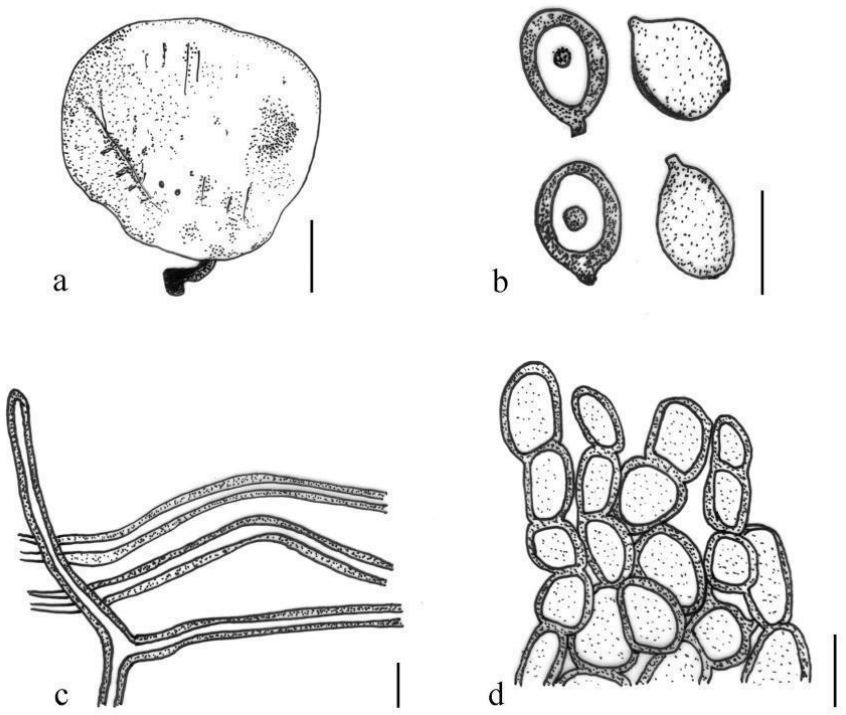


Fig. 9 – ***Gastropila fragilis***. a Basidiomata. b Basidiospores. c Eucapillitium. d Exoperidium hyphae. Scale bar: a = 1 cm, b = 5 µm, c = 10 µm, d = 20 µm. Redrawn from a = Rebriev & Assyov (2012), b−d = Cortez et al. (2012). For original basidiomata, refer to Revriev & Assyov (2012).

Morganella Zeller, Mycologia 40(6), 650

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 10

Classification: *Lycoperdaceae, Agaricineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Morganella was founded by S.M. Zeller in 1948, with its type species *M. mexicana* (Zeller 1948). The type species was based on specimens collected from wet areas among moss and leaves in Guaymas, Sonora, Mexico (Zeller 1948). Initially, Zeller (1948) placed this genus under *Mesophelliaceae* Jülich. In 1967, Kreisel and Dring amended the classification and classified it within *Lycoperdaceae* (Kreisel & Dring 1967, Alfredo et al. 2017). The peridium of *Morganella* consists of two layers, while *Mesophelliaceae* has three layers (Morales & Kimbrough 1981). Members of *Morganella* are found worldwide, mainly in tropical and subtropical regions (Rebriev & Bulakh 2015, He et al. 2019). They are primarily lignicolous and are rarely found in soil rich in organic matter (Kreisel & Dring 1967, Suarez & Wright 1996, Rebriev & Bulakh 2015).

Species of *Morganella* are characterised by their epigeous, depressed, globose to pyriform basidiomata, which consist of a double peridium (exoperidium and endoperidium) (Zeller 1948, Kreisel & Dring 1967, Suarez & Wright 1996, Rebriev & Bulakh 2015). The exoperidium is velutinous, furfuraceous, granular-verrucose, or spinulose, and may be flesh-coloured or deep red-brown to purplish black (Morales & Kimbrough 1981, Rebriev & Bulakh 2015). The endoperidium bears an apical opening with an irregularly torn mouth (Rebriev & Bulakh 2015). The gleba lacks true capillitium but contains abundant paracapillitium (Kreisel & Dring 1967, Suarez & Wright 1996, Rebriev & Bulakh 2015). Basidiospores are globose to broadly ovoid and may be asperulate to echinulate (Kreisel & Dring 1967, Zeller 1948, Suarez & Wright 1996, Rebriev & Bulakh 2015).

Recently, Li et al. (2024a) described a new species, *Morganella tricolor*, along with two new combinations, *M. oblongata* and *M. mengsongensis*, based on morphological characteristics and

phylogenetic analysis (ITS and LSU). *Morganella* differs from other genera in *Lycoperdaceae* by lacking capillitial threads (Morales & Kimbrough 1981). Additionally, in *Morganella*, the glebal membranes remain persistent in the mature gleba, while in other genera of the family, these membranes are disrupted and become unrecognisable (Morales & Kimbrough 1981). The classification of *Morganella* in *Lycoperdaceae* is in agreement in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a). Under *Morganella* , Species Fungorum (2026) lists 13 species worldwide.

Synonymy: *Lycoperdon* subgen. *Morganella* (Zeller) Jeppson & E. Larss.

Type species: *Morganella mexicana* Zeller

Other accepted species: (Species Fungorum – search *Morganella*)

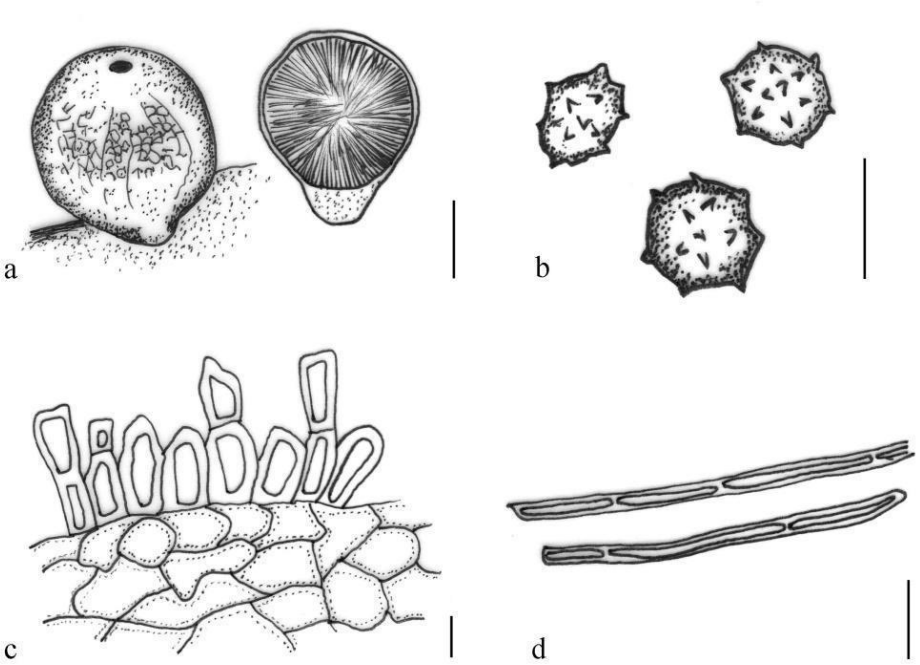


Fig. 10 – ***Morganella rimosa***. a Basidiomata. b Basidiospores. c Exoperidium. d Paracapilitium. Scale bar: a = 2 mm, b = 3 µm, c–d = 10 µm. Redrawn from Alfredo et al. (2012).

Lyophyllaceae Jülich, Bibliotheca Mycologica 85, 378

Species Fungorum, Facesoffungi, MycoBank, GenBank

Classification: *Tricholomatineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Lyophyllaceae was established by W. Jülich (1982), with *Lyophyllum* P. Karst. as the type genus (Jülich 1982). Species of *Lyophyllaceae* are characterised by the presence of macro-type siderophilous granulation in basidia (Jülich 1982, Hofstetter et al. 2014). Hofstetter et al. (2002) undertook the first phylogenetic analyses within *Lyophyllaceae*. Hyde et al. (2024a) listed 34 genera in this family. Members of *Lyophyllaceae* are distributed worldwide and exhibit a high degree of ecological diversity, ranging from saprophytic to parasitic or mutualistic lifestyles (Hofstetter et al. 2014, Bellanger et al. 2015). Some species in *Lyophyllaceae* are well-known edible mushrooms and are cultivated widely, such as *Lyophyllum shimeji* (Kawam.) Hongo and *Hypsizygus* Singer species (Bellanger et al. 2015).

Blastosporella T.J. Baroni & Franco-Mol., in Baroni, Franco-Molano, Lodge, Lindner, Horak & Hofstetter, Mycological Research 111(5), 579

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 11

Classification: *Lyophyllaceae, Tricholomatineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

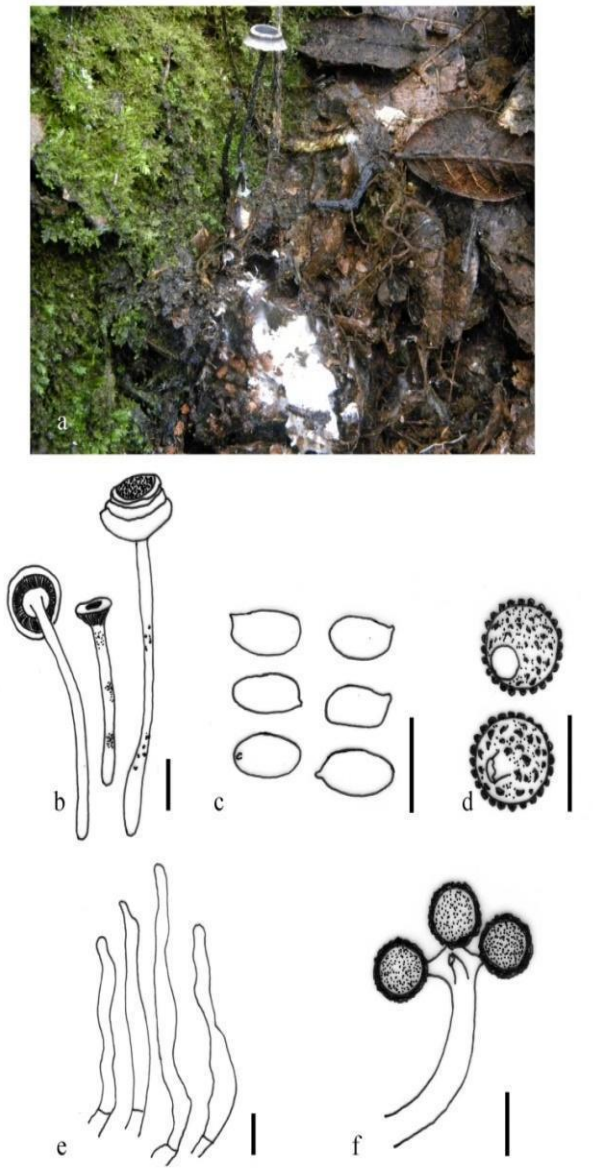


Fig. 11 – ***Blastosporella zonata*** (Corrales 211, holotype). a, b Basidiomata. c Basidiospores. d Blastospores. e Cheilocystidia. f Conidial heads from pileipellis. Scale bars: a = 10 mm, b–e = 10 μm. Redrawn from Baroni et al. (2007).

Blastosporella is a monotypic genus proposed by Baroni & Franco-Molano (Baroni et al. 2007, Hyde et al. 2024a), known for its unique morphological characteristics resembling lyophylloid agarics. The pileus is dark grey or fuscous over the disc due to the presence of powdery conidia. Pileus is zonate when young, with a broadly depressed disc that forms a rim-like edge. The pileus surface is radially fibrillose in the zonate areas and covered with spherical balls of blastospores, which produce conidia. The context consists of two layers: a white spongy upper layer and a brownish-grey solid lower layer. The lamellae are white to pale grey when young and turn dark greyish to black as they mature. They are adnate, emarginate, sinuate, or slightly decurrent. The hyphae have clamp connections. The stipe is brownish-grey at the apex, becoming paler toward the base or changing colour as it matures, and cheilocystidia are present. The basidia are clavate with four sterigmata, and the basidiospores are ellipsoid, round in polar view, hyaline, inamyloid, smooth, and cyanophilic (Baroni et al. 2007). One of the distinctive features of *Blastosporella* is its asexual form present on the cap, a trait similar to the genera *Arthromyces* T.J. Baroni & Lodge and *Mycena* (Pers.) Roussel. *Blastosporella* is found in Colombia and the

Dominican Republic, where it grows on soil among mosses and ferns, in leaf litter, and on decaying spiny fronds of *Cyathea* species, as well as on decaying leaves under *Quercus humboldtii* (Baroni et al. 2007, Franco-Molano et al. 2024). In addition, ITS, LSU, and *tef-1α* sequences of *Blastosporella* are available in the NCBI (2025). The classification of *Blastosporella* in *Lyophyllaceae* is in agreement in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Type species: *Blastosporella zonata* T.J. Baroni & Franco-Mol.

Gerhardtia Bon, Documents Mycologiques 24(93), 66

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 12

Classification: *Lyophyllaceae, Tricholomatineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Gerhardtia was established by M. Bon, based on *Lyophyllum* subgenus *Lyophyllopsis*, with *G. incarnatobrunnea* described as a type species (Bon 1994, Endo et al. 2022). However, *G. incarnatobrunnea* was synonymised with *G. borealis* (Fr.) Contu & A. Ortega, making the latter the new type species (Bon 1994, Vizzini et al. 2015, Endo et al. 2022). In *Lyophyllaceae*, *Gerhardtia* is uniquely characterised by the absence of clamp connections in its hyphae (Vizzini et al. 2015, 2017). Its species are saprotrophic and have a wide geographic distribution, occurring in Europe, New Zealand, North America, South America, China, Japan, and India (Izhar et al. 2021, Endo et al. 2022). Under *Gerhardtia,* Species Fungorum (2026) lists approximately 16 species worldwide.

Gerhardtia is characterised by basidiomata that vary in size (from small to large) and morphology (collybioid, tricholomatoid, or marasmioid), with pileus colours ranging from white to pale pink, greyish, lemon yellow, pale yellow, and yellowish to reddish brown (Qi et al. 2023). Initially, the genus was defined by the presence of verrucose basidiospores, basidia with siderophilous granules, a pileipellis structure (hymeniderm or trichoderm), and the absence of clamp connections (Bon 1994, Vizzini et al. 2015, Thapa et al. 2024b). The discovery of *G. pseudosaponacea* J.A. Cooper and P. Leonard led to an update in basidiospore descriptions, which could be either smooth or verrucose (Cooper 2014, Thapa et al. 2024b). Subsequently, the genus concept was further revised, with basidiospores described as irregular or undulate to nodulose rather than strictly verrucose (Vizzini et al. 2017, Thapa et al. 2024b).

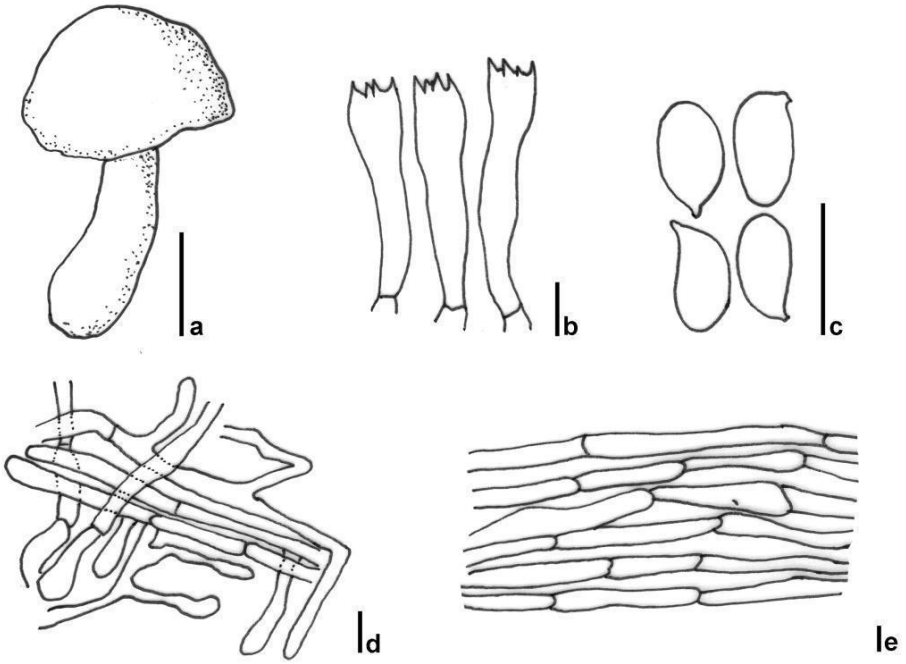


Fig. 12 – ***Gerhardtia foliicola*** (LAH 36419). a Basidiomata. b Basidia. c Basidiospores. d Pileus hyphae. e Stipe hyphae. Scale bar: a = 2 cm, b–e = 5 µm. Redrawn from Izhar et al. (2021).

Phylogenetically, *Gerhardtia* is sister to *Calocybella* Vizzini, Consiglio & Setti; however, the latter shows context reddening upon bruising, turning violaceous-red in alkaline solutions, and the presence of clamp connections (Vizzini et al. 2015). Endo et al. (2022) described *G. venosolamellata* as a new species based on morphological characteristics, phylogenetic analyses (ITS and LSU), and live culture characteristics. Mycelia of *G. venosolamellata* in culture produced arthroconidia through schizolytic and rhexolytic secession on malt extract agar (MEA) and potato dextrose agar (PDA), with occasional chlamydospores covered with crystals observed on MEA and malt extract-yeast extract-glucose agar (MYG) (Endo et al. 2022). The classification of *Gerhardtia* in *Lyophyllaceae* is in agreement in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Synonymy: *Lyophyllum* subgen. *Lyophyllopsis* Ew. Gerhardt

Type species: *Gerhardtia borealis* (Fr.) Contu & A. Ortega

Basionym: *Agaricus borealis* Fr.

Other accepted species: (Species Fungorum – search *Gerhardtia*)

Ossicaulis Redhead & Ginns, Transactions of the Mycological Society of Japan 26(3), 362

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 13, 14

Classification: *Lyophyllaceae, Tricholomatineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Ossicaulis was established by S.A. Redhead and J. Ginns in 1985, with its type species, *O. lignatilis* (Redhead & Ginns 1985, Qi et al. 2023). They are lignicolous, growing on decaying wood from Angiospermae, as well as on the decaying and live tree trunks of *Rhododendron* (Redhead & Ginns 1985, Yang et al. 2017a, Qi et al. 2023, Wei et al. 2023a). Species of *Ossicaulis* cause brown-rot and are found mainly in the north temperate region, and a few in China and Australia (Redhead & Ginns 1985, Qi et al. 2023).

The basidiomata of *Ossicaulis* are adnate, adnexed, or at most sub-decurrent lamellae, a regular trama, and a central to eccentric stipe. Basidiospores are small and ellipsoid (Holec & Kolařík 2013). Basidia contain siderophilous granules of the oligo type. Cheilocystidia are narrowly clavate to coralloid when present. Hyphae in the epicutis are coralloid and contain clamp connections (Redhead & Ginns 1985, Holec & Kolařík 2013). Notably, Clémençon (2005b) examined the rhizomorph anatomy of *O. lignatilis* and found that it strongly resembles haustoria, with broad, distinctive thromboplerous hyphae and their association with intrahyphal hyphae.

Wei et al. (2023a) described a new species, *O. sichuanensis*, based on specimens collected in China, using morphological characteristics and phylogenetic analyses (ITS and LSU). Qi et al. (2023) described another new species, *O. borealis*. Species Fungorum (2026) has recognised six species worldwide. The classification of *Ossicaulis* in *Lyophyllaceae* is in agreement in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).



Fig. 13 – ***Ossicaulis yunnanensis*** (HKAS 100527, holotype). Basidiomata. a Living on the tree trunk of *Rhododendron* sp. b Upper view. c Lower view. Scale bar: b, c = 2 cm. Photo credit: Yang et al. (2017a).

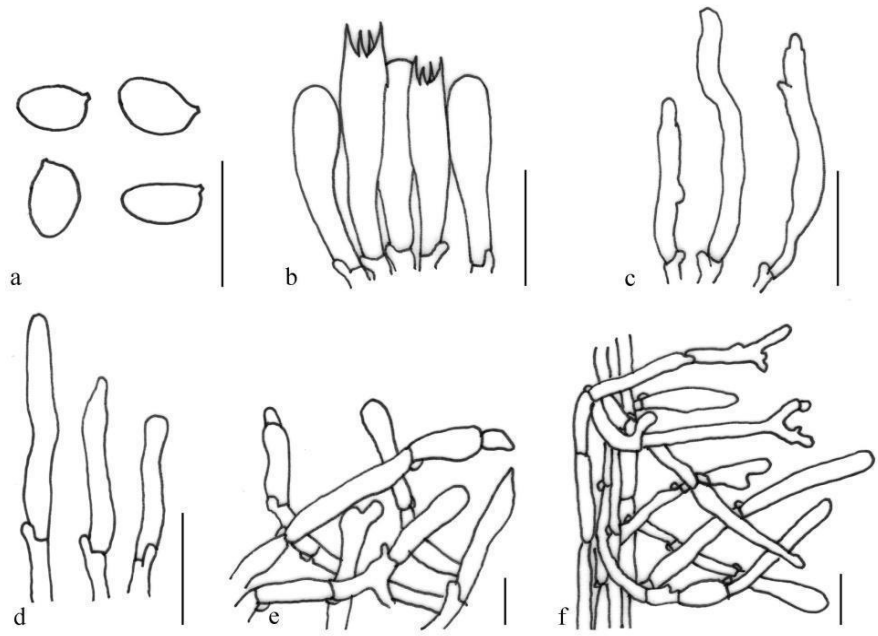


Fig. 14 – ***Ossicaulis yunnanensis*** (HKAS 100527, holotype). a Basidiospores. b Basidia and basidioles. c Cheilocystidia. d Pleurocystidia. e Pileipellis. f Stipitipellis. Scale bar: a = 5 μm, b–f = 10 μm. Redrawn from Yang et al. (2017a).

Type species: *Ossicaulis lignatilis* (Pers.) Redhead & Ginns
Basionym: *Agaricus lignatilis* Pers.
Other accepted species:
O. borealis X.D. Yu & H.B. Guo
O. salomii Siquier & Bellanger
O. semiocculta (Cleland) J.A. Cooper
O. sichuanensis S.W. Wei, Q. Wang & Yu Li
O. yunnanensis L.P. Tang, N.K. Zeng & S.D. Yang

Termitomyces R. Heim, Archives du Muséum d'Histoire Naturelle Paris, Série 6, 18, 147
Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 15
Classification: *Lyophyllaceae, Tricholomatineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Termitomyces was established by R. Heim in 1942 to accommodate 'termitophilous agarics' (Heim 1942). *Termitomyces* species form a symbiotic association with fungus-growing termites of *Macrotermitinae* and grow within a fungal comb constructed from termite faecal material (Ye et al. 2019, Usman & Khalid 2020). The termites create a suitable environment for the *Termitomyces*, while the fungus serves as a food source for the termites, demonstrating obligate interdependence and coevolution between them (Aanen et al. 2007, Kone et al. 2018). *Termitomyces* has a cosmopolitan distribution, mainly in Africa, Asia, and the Pacific islands (Morris 1986, Kone et al. 2018). Under *Termitomyces*, Species Fungorum (2026) recognised approximately 69 species worldwide. The genus is distinct from other agaric genera by its long stem (Morris 1986).

Termitomyces are characterised by basidiomata, which feature a pronounced umbo called perforatorium and a pseudorhiza that connects to the fungal comb (Usman & Khalid 2020). Pileus is initially conic to convex, then plane with maturity (Jannual et al. 2020). Lamellae are free, white to creamy, and usually crowded (Morris 1986). The stipe is central, cylindrical to subcylindrical, and has a longitudinally striated surface. An annulus is absent. The pseudorhiza is elongated and tapers toward the base (Jannual et al. 2020). Microscopically, basidiospores are ovoid to ellipsoid, smooth, thin-walled, inamyloid, cyanophilous, and exhibit a light pink deposit (Kaur et al. 2022).

Basidia are clavate to subcylindrical, four-spored, inamyloid, and contain siderophilous granulation (Clémençon 1984, Jannual et al. 2020). Cheilocystidia and pleurocystidia are abundant, clavate to pyriform, smooth, thin-walled, and inamyloid (Jannual et al. 2020). Hymenophoral trama may be either regular or bilateral (Kaur et al. 2022). Hyphae lack clamp connections.

The classification of *Termitomyces* in *Lyophyllaceae, Agaricales, Agaricomycetidae, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* is in agreement in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Ediriweera et al. (2023) described a new species, *T. srilankensis* Ediriweera, Voto, Karun. & Kularathne, utilising morphological characteristics and phylogenetic analyses (ITS). *Termitomyces* species have socio-economic and ecological values. They are widely consumed as a medicinal and nutritious delicacy in different regions, including equatorial Africa and Southeast and South Asia (Turnbull & Watling 1999, Aryal & Budathoki 2016). Proteomic analysis of an edible termite mushroom, *T. heimii* Natarajan, has revealed correlations between protein expression and developmental stages (Rahmad et al. 2014). Additionally, *Termitomyces* species are known sources of active compounds, including nectrianolins and termitomycesphins G and H (Qu et al. 2012, Kreuzenbeck et al. 2023). *Termitomyces striatus* has demonstrated antimicrobial properties and serves as a source of antimicrobial and antifungal compounds (Mahamat et al. 2018, Sitati et al. 2021).

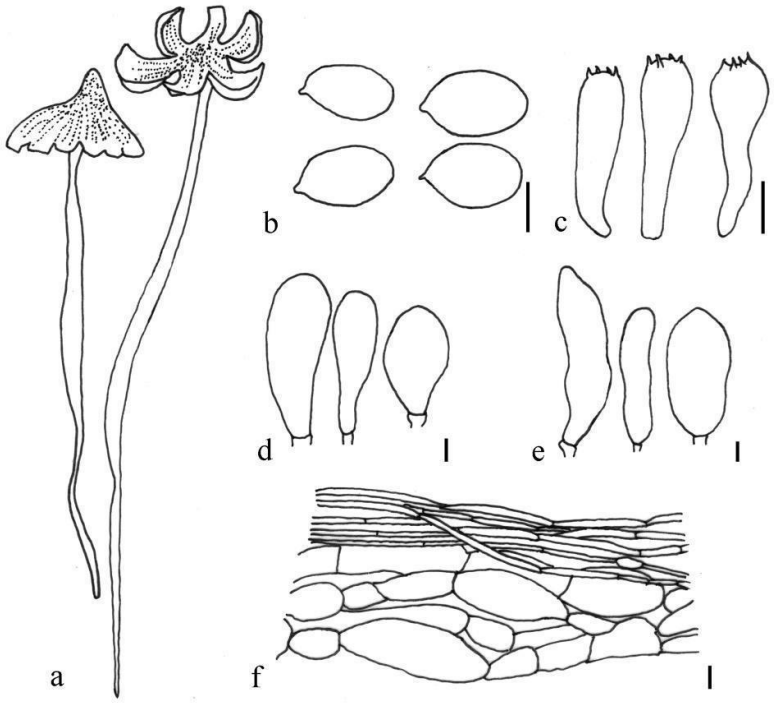


Fig. 15 – ***Termitomyces fragilis*** (HKAS 88912, holotype). a Basidiomata. b Basidiospores. c Basidia. d Cheilocystidia. e Pleurocystidia. f Pileipellis. Scale bar: b = 5 µm, c–f = 10 µm. Redrawn from Ye et al. (2019). For original basidiomata, refer to Ye et al. (2019).

Synonymy: *Podabrella* Singer, *Rajapa* Singer, *Sinotermitomyces* M. Zang
Type species: *Termitomyces striatus* (Beeli) R. Heim
Basionym: *Schulzeria striata* Beeli
Other accepted species: (Species Fungorum – search *Termitomyces*)

Tricholomella Zerova ex Kalamees, Persoonia 14(4), 446
Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 16
Classification: *Lyophyllaceae, Tricholomatineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Tricholomella, a monotypic genus, was originally named by Zerova in 1974, but without a Latin description. The genus was validated by Kalamees in 1992, which confirmed the position of the genus in the family *Lyophyllaceae* Jülich. The genus was originally described with two species, with *T. constricta* as the type species, distinct in having a non-rooting stipe without an annulus (Kalamees 1992). However, *T. leucocephala* (Bull.) Zerova ex Bon, which was characterised by a rooting stipe with an annulus, was invalid, and the current status of the genus remains monotypic (Akçay 2019, Wijayawardene et al 2022, Hyde et al 2024a). It is typically found with fruits on soil amid grass in woodland clearings or at the edges of forests, in steppes, meadows, and pastures, occurring with either deciduous or coniferous trees (Kalamees 1992, Akçay 2019). Notably, it is often observed in spots where animals, particularly dogs, have urinated (Akçay 2019). The genus is distributed in Asia and Eastern Europe, including Estonia and Turkey (Kalamees 1992, Akçay 2019, Sesli & Aytaç 2019).

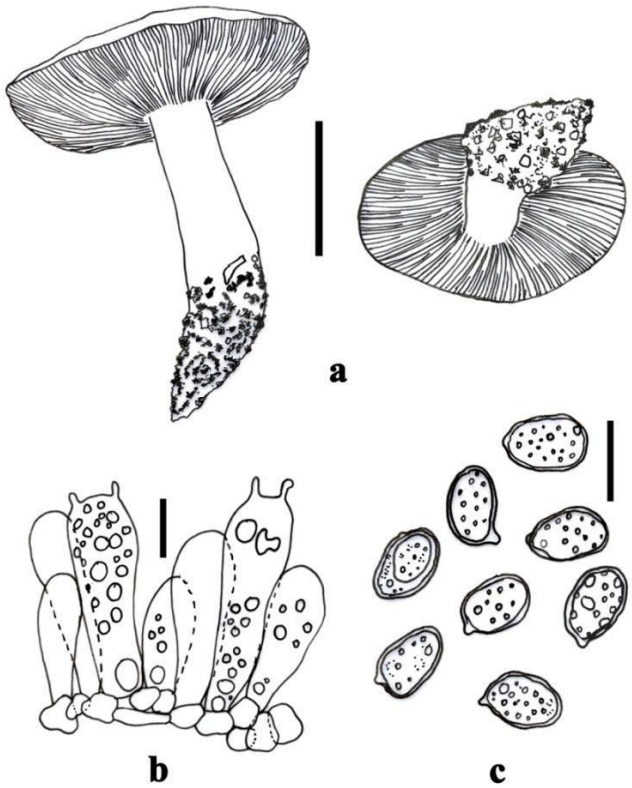


Fig. 16 – ***Tricholomella constricta*** (TAA 51279, holotype). a Basidiomata. b Basidia and basidioles. c Basidiospores. Scale bars: a–c = 10 µm. Redrawn from Sesli & Aytaç (2019). For original basidiomata, refer to Akçay (2019) and Sesli & Aytaç (2019).

The basidiomata of *Tricholomella* are tricholomatoid forms that are unpigmented and white, thick, fleshy, and either small or medium in size. The stipe initially bears a ring (annulus), which disappears as the mushroom matures, and occasionally exhibits a rooting base. Basidiomata have the distinctly farinaceous (mealy) odour and taste. The gills are emarginate to nearly free from the stipe. The hymenophoral trama is regular in arrangement, having the typical four-spored basidia, and lacks hymenial cystidia. All hyphae exhibit clamp connections and a cutis type of pileipellis. Basidiospores are hyaline, large, elliptic to ovate, with echinulate surfaces, inamyloid and cyanophilous (Kalamees 1992).

A phylogenetic analysis of the ITS of some selected genera of the family *Lyophyllaceae* was conducted, which also inferred that the two species recognised under the genus are not genetically too different, and can be considered conspecific. A new description is needed, including the members with or without annulus to separate the two (Sesli & Aytaç 2019). Various authors have

classified *Tricholomella* under different genera, including *Tricholoma* (Fr.) Staude, *Armillaria* Kumm., *Lyophyllum* P. Karst., *Calocybe* Kühner ex Donk, *Lepiota* (Pers.) S.F. Gray, and *Melanoleuca* Pat. The genus *Tricholomella* can be distinguished from the first five genera by the presence of echinulate spores, and from *Melanoleuca* by its inamyloid spores (Kalamees 1992). The presence or absence of siderophilous granules in the genus is unclear and has caused confusion. It has been suggested that *Tricholomella* may be related to *Lyophyllum* or *Calocybe*, in which case these granules are expected to be present; however, no study has been able to confirm this (Kalamees 1992, Sesli & Aytaç 2019). Similarly, *Tricholomella* basidia do not have siderophilous granules (Kalamees 1992). The classification of *Tricholomella* in *Lyophyllaceae, Tricholomatineae*, *Agaricales, Agaricomycetidae, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* is in agreement in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Synonyms: *Echinosporella* Contu, *Tricholomella* Zerova

Type species: *Tricholomella constricta* (Fr.) Zerova ex Kalamees

Basionym: *Agaricus constrictus* Fr.

Macrocystidiaceae Kühner, Bulletin Mensuel de la Société Linnéenne de Lyon 48(3), 172

Species Fungorum, Facesoffungi, MycoBank, GenBank

Classification: *Tricholomatineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Macrocystidiaceae is a family established by R. Kühner (1979) with *Macrocystidia* Joss. as the type genus (Kühner 1979, He et al. 2019). The second genus is *Pseudoclitopilus* Vizzini & Contu. *Macrocystidiaceae* is the only family in the suborder *Macrocystidiineae* H. Qu, Z.W. Ge & Zhu L. Yang (Qu et al. 2025). *Macrocystidiaceae* is characterised by gymnocarpic mycenoid to collybioid basidiomata, with almost free lamellae, regular to subregular hymenophoral trama, lageniform to fusiform, thin-walled cystidia, and ellipsoid, thick-walled, cyanophilous, inamyloid, and mononucleate basidiospores (Kühner 1979, Læssøe & Petersen 2019, Vizzini et al. 2024). Members of *Macrocystidiaceae* are saprophytic and distributed worldwide (He et al. 2019).

Macrocystidia Joss., Bulletin Trimestriel de la Société Mycologique de France 49(3–4), 373, 376

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 17

Classification: *Macrocystidiaceae, Tricholomatineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota*, *Fungi*

Macrocystidia was established by M. Josserand in 1934, with *M. cucumis* as the type species (Josserand 1934). The type species was initially described as *Agaricus cucumis*, based on specimens collected from soil associated with *Fagus* and *Pinus* (Persoon 1796). Kühner (1979) introduced *Macrocystidiaceae* to accommodate *Macrocystidia*, and its family-level status has been supported by Vizzini et al. (2024). However, its taxonomic placement at the family level has remained controversial (Moncalvo et al. 2002). Species of *Macrocystidia* are saprobic and are distributed worldwide (He et al. 2019).

Macrocystidia are characterised by collybioid to mycenoid basidiomata with a glabrous, hygrophanous pileus. The stipe is central, rigid, slender, and glabrous, and lacking pseudorrhiza. The epicutis consist of repent, filamentous hyphae with numerous large dermatocystidia. Basidiospores are smooth, inamyloid, slightly thick-walled, and produce an ocher-reddish (or pinkish) spore deposit (Singer 1964a). Gloeocystidia are abundant (Singer 1964a, Izhar et al. 2022), and the hymenial trama is regular and inamyloid (Singer 1964a).

Under *Macrocystidia,* Species Fungorum (2026) lists only 8 species worldwide. Liu et al. (2025) introduced a new species, *Macrocystidia hebeiensis*, based on morphological characteristics and phylogenetic analyses (ITS, LSU, SSU, *rpb1*, *rpb2*, *tub*, and *tef-1α*) of specimens collected in China. Phylogenetic evidence also indicated that *Macrocystidia* is closely related to *Pseudoclitopilus* Vizzini & Contu (Liu et al. 2025). The classification of *Macrocystidia* in *Macrocystidiaceae, Tricholomatineae*, *Agaricales, Agaricomycetidae, Agaricomycetes,*

Agaricomycotina, and *Basidiomycota* is in agreement in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

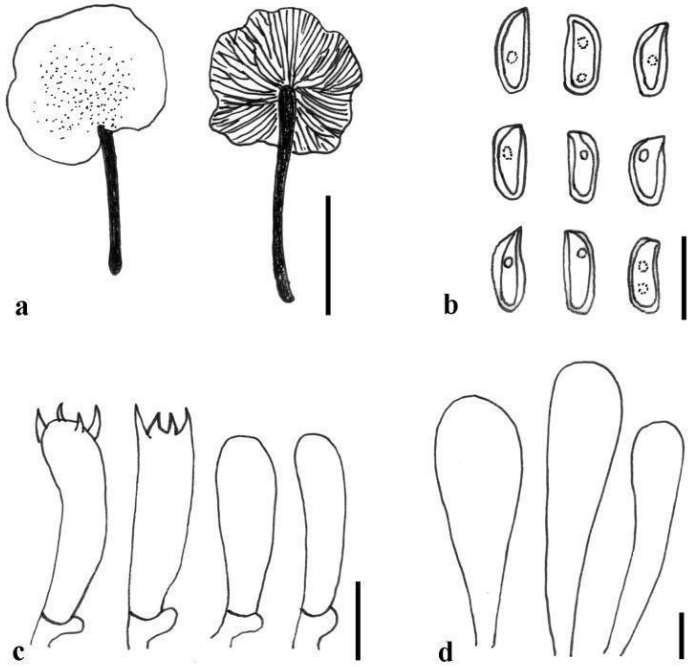


Fig. 17 – ***Macrocystidia hebeiensis*** (Liu 67, holotype). a Basidiomata. b Basidiospores. c Basidia and basidioles. d Cheilocystidia. Scale bar: a = 3 cm, b–d = 10 µm. Redrawn from Liu et al. (2025). For original basidiomata, refer to Liu et al. (2025).

Synonyms: *Galeromycena* Velen., *Macrocystis* R. Heim
Type species: *Macrocystidia cucumis* (Pers.) Joss.
Basionym: *Agaricus cucumis* Pers.
Other accepted species:
M. africana Singer
M. hebeiensis Shun Liu & Biao Zhu
M. incarnata Singer
M. indica Saini, Atri & Singer
M. occidentalis Singer
M. reducta E. Horak & Capellano
M. tashanparensis J.Z. Xu

Mythicomycetaceae Vizzini, Consiglio & M. Marchetti, Fungal Systematics and Evolution 3, 46
Species Fungorum, Facesoffungi, MycoBank, GenBank
Classification: *Agaricineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Mythicomycetaceae was established by A. Vizzini, G. Consiglio & M. Marchetti in 2019 under suborder *Agaricineae* Fr., with *Mythicomyces* Redhead & A.H. Sm. as the type genus (Vizzini et al. 2019). He et al. (2024) and Hyde et al. (2024a) reported two genera in this family, *Mythicomyces* and *Stagnicola* Redhead & A.H. Sm. *Mythicomycetaceae* is characterised by a mycenoid to phaeocollybioid basidiomata, with the absence of veils, a cartilaginous-horny, often tapering stipe, smooth or minutely punctate-verruculose basidiospores without a germ pore, and a greyish brown, pale hazel brown spore print (Vizzini et al. 2019). Cheilocystidia can be either metuloids or as thin-walled elements, while pleurocystidia, when present, are metuloids. Pileipellis are thin ixocutis without cystidioid elements but always clamped. Members of *Mythicomycetaceae*

are distributed in the Northern Hemisphere, in boreal, subalpine, and montane coniferous forests, and are saprophytic on wood debris (Vizzini et al. 2019).

Stagnicola Redhead & A.H. Sm., Canadian Journal of Botany 64(3), 645
Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 18
Classification: *Mythicomycetaceae, Agaricineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Stagnicola is a monotypic genus established by S.A. Redhead and A.H. Smith in 1986, with its type species *S. perplexa* (Redhead & Smith 1986, He et al. 2019, Hyde et al. 2024a). The type species was originally classified as *Phaeocollybia perplexa*, based on specimens collected from rotten wood of Coniferae in England (Orton 1977). *Stagnicola* is saprotrophic and distributed across Europe and North America. This genus is typically found on decaying plant debris in damp, moist environments, including coniferous forests and acid soils (Vizzini et al. 2019).

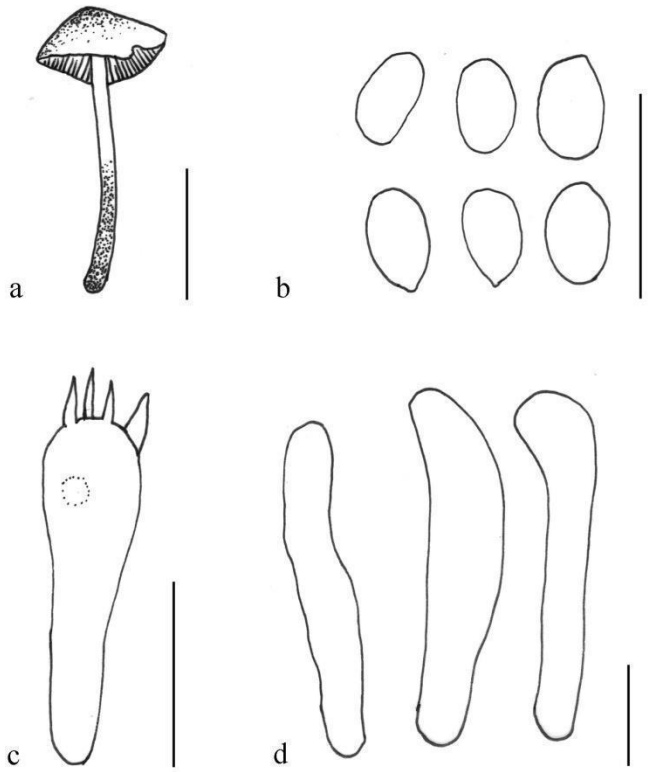


Fig. 18 – ***Stagnicola perplexa***. a Basidiomata. b Basidiospores. c Basidia. d Cheilocystidia. Scale bar: a = 1 cm, b−d = 10 μm. Redrawn from Vizzini et al. (2019).

Stagnicola is characterised by mycenoid or collybioid to phaeocollybia-like basidiomata (Vizzini et al. 2019). The pileus is conical to convex, umbonate, hygrophanous, smooth, lubricous-viscid to greasy, striate, tawny, fulvous to sienna, with an orange-yellowish at the margin. *Lamellae* are adnexed-ventricose and crowded, with olivaceous tints and a concolourous edge. The stipe is central, smooth, horny, cartilaginous, shiny, purplish red, darkening to brown or blackish toward the base, with basal mycelial tomentum. Basidiospores are ellipsoid to amygdaliform-reniform, smooth, hyaline, non-dextrinoid, inamyloid, cyanophilous, lacking a germ pore, and with a deep olive buff to pale hazel brown spore print. Basidia are typically 4-spored, occasionally 1-2-spored. Cheilocystidia are thin-walled, cylindrical to fusiform, while pleurocystidia are absent. The hymenophoral trama consists of regular, parallel hyphae. The pileipellis is a thin ixocutis of encrusted hyphae with yellow-brown pigment. Both caulocystidia and clamp connections are present (Vizzini et al. 2019).

Vizzini et al. (2019) used morphological and phylogenetic analysis (ITS, LSU, SSU, and *rpb2*) to distinguish this species from other closely related genera. *Stagnicola* shares similarities with *Simocybe* P. Karst., but the latter differs in having olivaceous tinges on the pileus surface, more pigmented and distinctly ovoid-reniform basidiospores, and a trichodermic-hymenidermic pileipellis with well-developed pileocystidia (Horak & Ronikier 2011, Vizzini et al. 2019). *Stagnicola* also differs from its close genus *Mythicomyces* by lacking verrucose basidiospores, thick-walled hymenial cystidia, and purple hues in its spore deposit (Vizzini et al. 2019). The taxonomic classification of *Stagnicola* is placed under *Mythicomycetaceae, Agaricineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota,* in Species Fungorum, GenBank, MycoBank, and Hyde et al. (2024a); however, UNITE places it under *Cortinariaceae* and it may require an update.

Type species: *Stagnicola perplexa* (P.D. Orton) Redhead & A.H. Sm.

Basionym: *Phaeocollybia perplexa* P.D. Orton

Psathyrellaceae Vilgalys, Moncalvo & Redhead, in Redhead, Vilgalys, Moncalvo, Johnson & Hopple, Taxon 50(1), 226

Species Fungorum, Facesoffungi, MycoBank, GenBank

Classification: *Agaricineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Psathyrellaceae was established by S.A. Redhead, R. Vilgalys, J.M. Moncalvo, J. Johnson & J.S. Jr Hopple with *Psathyrella* (Fr.) Quél. as the type genus (Redhead et al. 2001). Hyde et al. (2024a) reported 21 genera in this family. *Psathyrellaceae* is characterised by small to large, smooth to innately fibrillose, white to dark reddish-brown basidiomata, with dark basidiospores (Nagy et al. 2013, Örstadius et al. 2015). Many species in *Psathyrellaceae*, commonly known as inky caps, are fragile and deliquescent, exhibiting the ability to digest themselves through autodigestive chitinases and turning into a blackish inky fluid (Kües 2000, Nagy et al. 2013, Örstadius et al. 2015). Members of *Psathyrellaceae* are distributed worldwide and are saprotrophic, commonly growing mainly on wood and plant residue (Örstadius et al. 2015).

Cystoagaricus Singer, Mycologia 39(1), 85

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 19

Classification: *Psathyrellaceae, Agaricineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Cystoagaricus was established by Rolf Singer, with *C. strobilomyces* as the type species. Initially, this species was classified as *Nolanea strobilomyces* Murril (Singer 1947). The type specimen was collected from decayed wood in Alachua County, USA. Species of *Cystoagaricus* are distributed across subtropical regions of America and Europe, including the USA, Argentina, Germany, Ecuador, and France (He et al. 2019). Under *Cystoagaricus*, Species Fungorum (2026) recognised 12 species worldwide.

Cystoagaricus is characterised by small to medium-sized, non-deliquescent basidiomata, often found on wood (lignicolous) (Örstadius et al. 2015, Muñoz et al. 2022). Pileus exhibits a wide range of colours, including grey, brown, orangish, dark brown, or occasionally olivaceous. Its surface may be fibrillose, squamulose, spiny, or squarrose, with or without striations, and a veil. Lamellae are often crowded, adnate to adnexed, and initially greyish, becoming dark brown with age. Stipe is fibrillose, often displaying velar remnants on its lower portion. Context is whitish and may darken with age. Basidiospores are small to medium-sized, irregular, and typically troncoconic, subtroncoconic, subrectangular, or mitriform forms. Cheilocystidia and pleurocystidia are present, often utriform or clavate in shape (Örstadius et al. 2015, Muñoz et al. 2022).

Örstadius et al. (2015) illustrated morphological characteristics and phylogenetic analyses (ITS, LSU, *β-tub*, and *tef-1α*) to delineate species within *Cystoagaricus. Cystoagaricus* shares similarities with the genus *Nolanea,* particularly in having angular basidiospores. However, the two genera differ in shape and colour of their basidiospores, as well as the size and shape of their

basidia. The basidia of *Nolanea* are typically larger and narrower compared to those of *Cystoagaricus* (Singer 1947). The classification of *Cystoagaricus* in *Psathyrellaceae, Agaricineae*, *Agaricales, Agaricomycetidae, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* is in agreement in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Type species: *C. strobilomyces* (Murrill) Singer

Basionym: *Nolanea strobilomyces* Murrill

Other accepted species: (Species Fungorum – search *Cystoagaricus*)

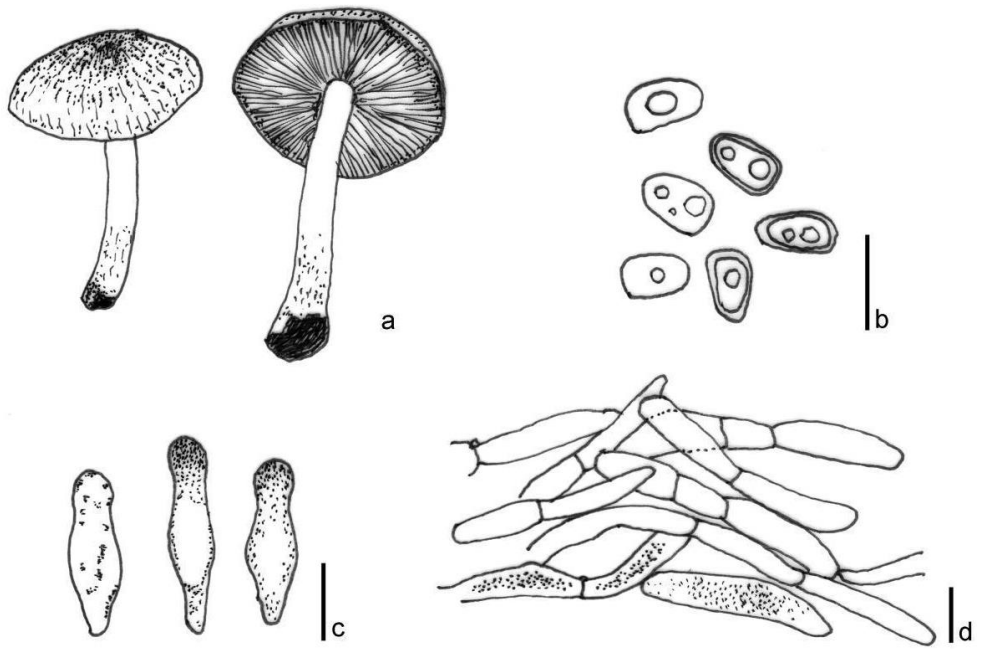


Fig. 19 – ***Cystoagaricus lepidotoides*** (GM2552). a Basidiomata. b Basidiospores. c Pleurocystidia. d Universal veil. Scale bar: a = 10 µm, b–d = 20 µm. Redrawn from Muñoz et al. (2022).

Gasteroagaricoides D.A. Reid, Transactions of the British Mycological Society 86(3), 431

Species Fungorum, Facesoffungi, MycoBank Fig. 20

Classification: *Psathyrellaceae, Agaricineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Gasteroagaricoides, a monotypic genus, was established by E.A. Reid in 1986, with its type species *G. ralstoniae* (Reid 1986, Hyde et al. 2024a). This species was originally described based on specimens collected from debris between rotting logs in Norfolk Island, Australia (Reid 1986). Notably, *Flabellimycena* is listed in the "List of protected generic names of fungi" under the International Code of Nomenclature for algae, fungi, and plants (Kirk et al. 2013).

Gasteroagaricoides is characterised by its agaricioid basidiomata, with a convex, granular-verrucous cap and strongly curved margin (Reid 1986). The pileus surface is covered with thin-walled, globose, ovate, or fusiform warts. The hymenium consists of very thin lamellae with basidia interspersed with large globose cells (brachycystidia, pseudoparaphyses) but lacks cystidia. Basidiospores are symmetrical, elongate-elliptic, smooth, hyaline or sub-hyaline, with distinct walls but lack a germ pore. The hyphae have slightly thickened walls and bear clamp connections (Reid 1986).

Species delineation of *Gasteroagaricoides* is based solely on macro- and micro-morphological characteristics, as no molecular sequences are available (Reid 1986, He et al. 2019). *Gasteroagaricoides* is morphologically similar to *Jugisporipsathyra* J.Q. Yan, Y.G. Fan & S.N. Wang (Wang et al. 2022). However, the latter is distinct from *Gasteroagaricoides* by having a smooth and reticulate-ridged pileus. The genus is placed in *Psathyrellaceae*, though molecular

evidence is needed to differentiate it from closely related genera (Wang et al. 2022). The classification of *Gasteroagaricoides* in *Psathyrellaceae, Agaricineae*, *Agaricales, Agaricomycetidae, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* is in agreement in Species Fungorum, MycoBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Type species: *Gasteroagaricoides ralstoniae* D.A. Reid

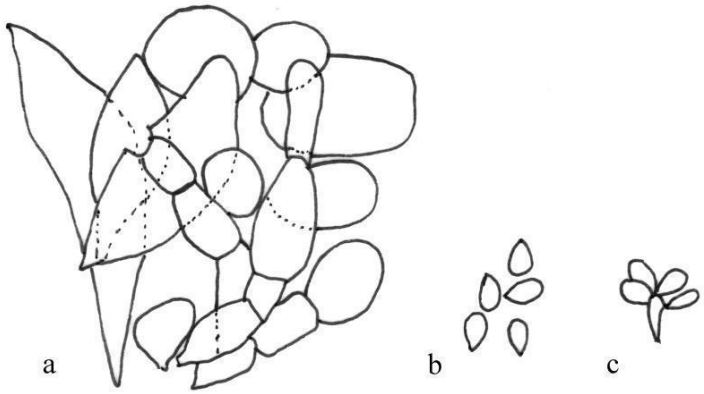


Fig. 20 – ***Gasteroagaricoides ralstoniae***. a Thin-walled element comprising the pileal warts (×666). b Basidiospores (×666). c Basidiospores attached to a basidium (×666). Redrawn from Reid (1986).

Macrometrula Donk & Singer, in Singer, Mycologia 40(2), 264

Species Fungorum, Facesoffungi, MycoBank Fig. 21

Classification: *Psathyrellaceae, Agaricineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Macrometrula, a monotypic genus, was introduced by M.A. Donk and R. Singer in 1948, and its type species is *M. rubriceps* (Singer 1948, Wijayawardene et al. 2022, Hyde et al. 2024a). The type species was initially classified as *Agaricus rubriceps*, based on a specimen collected from soil in the Aroid house at Kew Gardens, England (Singer 1948). The genus is rare, as no additional specimens have been discovered since its initial description (Shaw 1961).

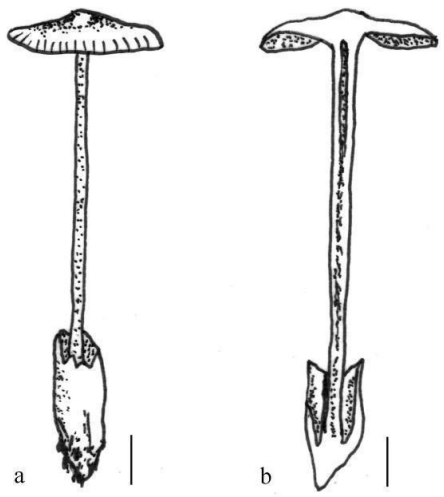


Fig. 21 – ***Macrometrula rubriceps***. a Basidiomata. b Vertical Section of basidiomata. Scale bar: a–b = 1 cm. Redrawn from Kew Botanic Garden, catalogue number: K-M000165895. For original basidiomata, refer to Kew Botanic Garden.

Macrometrula is characterised by fleshy, campanulate to expanded, umbonate, and smooth basidiomata (Cooke 1887). The margin is faintly striate, and the gills are free, lanceolate, crowded, and purplish brown. The stipe is erect, fistulose, paler than the pileus, and bears mycelial roots. The volva is saccate, whitish, and torn at the margin (Cooke 1887). Basidiospores are pale brownish, subregular, and inamyloid and feature a wide, flattened germinative pore (Singer 1948, Shaw 1961). The basidia are four-spored. The cystidia are ventricose upwards and attenuate or subcapitate at the apex (Singer 1948).

Macrometrula is reported only through macro- and micro-morphological characteristics, and molecular sequences are lacking (He et al. 2019). *Macrometrula* is morphologically closely related to *Psathyrella* (Fr.) Quél. in their anatomy; however, the former is distinguished by its large, cup-shaped saccate volva (Singer 1948). The classification of *Macrometrula* in *Psathyrellaceae, Agaricineae*, *Agaricales, Agaricomycetidae, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* is in agreement in Species Fungorum, MycoBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Type species: *Macrometrula rubriceps* (Cooke & Massee) Donk & Singer

Basionym: *Agaricus rubriceps* Cooke & Massee

Strophariaceae Singer & A.H. Sm., Mycologia 38(5), 503

Species Fungorum, Facesoffungi, MycoBank, GenBank

Classification: *Agaricineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota*, *Fungi*

Strophariaceae was established by R. Singer & A.H. Smith with *Stropharia* (Fr.) Quél. as the type genus (Singer & Smith 1946). Hyde et al. (2024a) reported 14 genera in this family: *Agrocybe* Fayod, *Bogbodia* Redhead, *Brauniella* Rick ex Singer, *Deconica* (W.G. Sm.) P. Karst., *Hemipholiota* (Singer) Bon, *Hypholoma* (Fr.) P. Kumm., *Kuehneromyces* Singer & A.H. Sm., *Leratiomyces* Bresinsky & Manfr. Binder ex Bridge, Spooner, Beever & D.C. Park, *Melanotus* Pat., *Pholiota* (Fr.) P. Kumm., *Protostropharia* Redhead, Moncalvo & Vilgalys, *Pseudogymnopilus* Raithelh., *Pyrrhulomyces* E.J. Tian & Matheny, and *Stropharia*. *Strophariaceae* is characterised by agaric basidiomata, with cylindrical to narrowly clavate basidia, violaceous basidiospores with germ pores, and monomitic hyphal system (Cho et al. 2016). Members of *Strophariaceae* are distributed worldwide and are mainly saprophytic (soil, dung, grass root, plant litter), and some species are ectomycorrhizal (Cho et al. 2016, Lebel et al. 2022). Some species of this family are considered potentially medicinal mushrooms with anticancer properties (Song et al. 1998, Cho et al. 2016).

Agrocybe Fayod, Annales des Sciences Naturelles, Botanique, Série 7, 9, 358

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 22

Classification: *Strophariaceae, Agaricineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota*, *Fungi*

Agrocybe was established by V. Fayod in 1889, with *A. praecox* as the type species (Fayod 1889). Members of *Agrocybe* are saprophytic, growing in forest grassland, on dung, or debris (Niveiro et al. 2020, Li et al. 2023a, Zhang et al. 2024), and are widely distributed in temperate regions of Asia, Europe, and North America (Flynn & Miller 1990, Li et al. 2023a). Under *Agrocybe,* Species Fungorum (2026) recognised approximately 121 species worldwide. Singer (1986) initially classified *Agrocybe* within *Bolbitiaceae* Singer, based on characteristics such as the pear-shaped to subspherical spherocytes of the pileipellis, the presence or absence of hymenial cystidia, and brown spore prints. Additionally, this genus was separated into two subgenera, *Agrocybe* subg. *Agrocybe* Fayod and subg. *Aporus* Singer (Singer 1986). *Agrocybe* subg. *Agrocybe* was further divided into five sections (*Agrocybe*, *Pediades*, *Microsporae*, *Allocystides*, and *Evelatae*), while the latter comprised two sections (*Aporus* and *Velatea*) (Singer 1986). Subsequent taxonomic revision transferred the section *Evelatae* to the subgenus. *Aporus* and eliminated section *Allocystides* (Watling 1982). However, recent molecular phylogenetic analyses support the

placement of *Agrocybe* under *Strophariaeae* Singer & A.H. Sm. (Walther & Weiß 2006, Kirk et al. 2008, He et al. 2019). Notably, phylogenetic analyses based on ITS and LSU regions have revealed that *Agrocybe* is polyphyletic (Matheny et al. 2006, Kiyashko et al. 2022).

Members of *Agrocybe* are characterised by small to medium-sized basidiomata with a membranous ring (Niveiro et al. 2020, Li et al. 2023a). The pileus is semiglobate, fleshy, and either smooth or slightly wrinkled (Zhang et al. 2024). The stipe is white, buff, or ochraceous in colour and bears a distinct ring. The context is white or pale-coloured and exhibits a mealy taste and smell (Zhang et al. 2024). Basidiospores are ovoid, ellipsoid, or fusiform, smooth, thick-walled, yellow to light-brown, bear broad germ pores, and have a brown spore print (Niveiro et al. 2020, Li et al. 2023a, Zhang et al. 2024). The pileipellis is hymeniderm or ixohymeniderm (Niveiro et al. 2020, Li et al. 2023a).

Li et al. (2023a) described a new species, *Agrocybe striatipes* R.L. Zhao & J. Xin Li from China, based on a combination of morphological characteristics and phylogenetic analyses (ITS and LSU). The type species, *A. praecox*, has been domesticated for food (Wu et al. 2020, Kartal et al. 2022). Several species of *Agrocybe* are reported to be rich in secondary metabolites with anti-cancer, anti-obesity, anti-tumour, anti-ageing, and hypoglycemic properties (Wu et al. 2020, Kartal et al. 2022, Zhang et al. 2024). Members of this genus exhibit hydrolytic and lignolytic enzymatic activities, which makes the mushrooms popular for bioremediation (Kartal et al. 2022). The taxonomic classification of *Agrocybe* is placed under *Strophariaceae* in UNITE and Hyde et al. (2024a); however, Species Fungorum, GenBank, and MycoBank place it under *Agrocybaceae* and it may require an update.

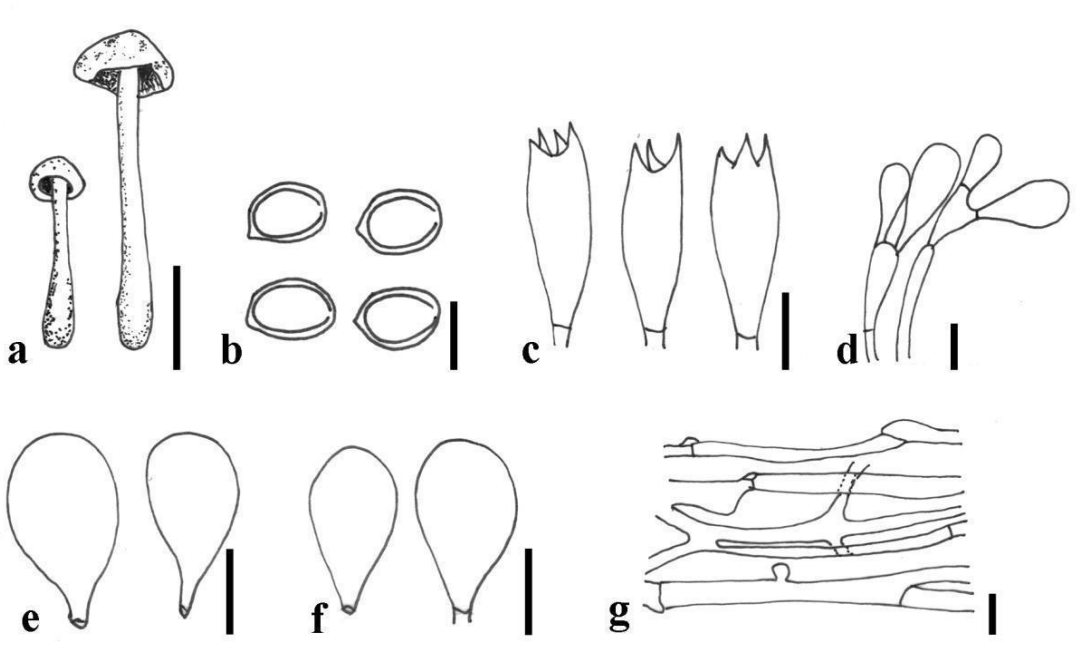


Fig. 22 – ***Agrocybe striatipes*** (HMAS486942, holotype). a Basidiomata. b Basidiospores. c Basidia. d Pileipellis hyphae. e Cheilocystidia. f Pleurocystidia. g Stipitipellis hyphae. Scale bar: a = 2 cm, b–g = 5 µm. Redrawn from Li et al. (2023a). For original basidiomata, refer to Li et al. (2023a).

Synonymy: *Bulla* Battarra ex Earle, *Bulla* Battarra, *Cyclopus* (Quél.) Barbier, *Hylophila* subgen. *Cyclopus* Quél., *Pseudodeconica* Overeem, *Togaria* W.G. Sm.

Type species: *Agrocybe praecox* (Pers.) Fayod

Basionym: *Agaricus praecox* Pers.

Other accepted species: (Species Fungorum – search *Agrocybe*)

Brauniella Rick ex Singer, Mycologia 47(5), 776

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 23

Classification: *Strophariaceae, Agaricineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota*, *Fungi*

Brauniella, a monotypic genus, was initially described as the type genus of *Brauniellaceae* Singer (Singer 1962b, Hyde et al. 2024a). *Brauniellaceae* is characterised by basidiomata with an elongate stipe having a basal volva and stramineous, inamyloid, and smooth-walled basidiospores (Singer 1962b). However, *Brauniella* has recently been classified in *Strophariaceae* Singer & A.H. Sm. (He et al. 2019). *Brauniella* is a monotypic genus represented by *Brauniella alba* (Rick) Rick ex Singer. It is characterised by conical gasteroid basidiomata, with appressed margins to the stipe-columella. The peridium is white, woolly underneath the outer layer grey, while the flesh is coloured and lacunose, with the gleba but loculi in sublamellar arrangement attached concrescent with the columella. The stipe-columella is white, fibrous, smooth, longitudinally cracked, and inconspicuous when young and elongated at maturity with a thin, membranous, white basal volva. White rhizomorphs are also present. The context is white, fleshy to brittle, and remains unchanged on cut or exposure to air. Basidiospores are ellipsoidal to subfusoid, inamyloid, smooth, and slightly thick-walled, with intimately agglutinated endo- and episporium separated at the hilar end; hilar ends vary from knob-shaped to mucronate tooth-shaped. Basidia are clavate-turbinate, hyaline, straight or half-sickle-shaped sterigmata, 4-spored. Hymenophoral trama composed of inamyloid, non-gelatinised, thin-walled, septate hyphae intermixed with oleiferous hyphae. Cortex comprises interwoven hyphae in the outer layer of the peridium and is poorly differentiated.

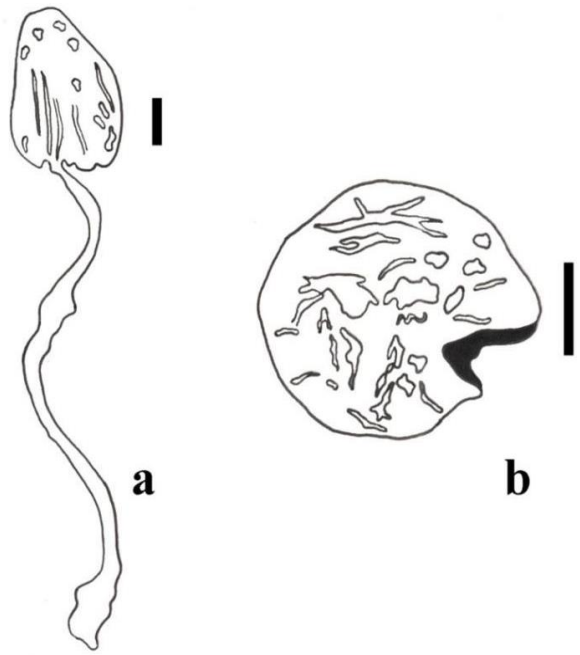


Fig. 23 – ***Brauniella alba*** (holotype). a–b Basidiomata. Scale bars: a–b = 10 µm. Redrawn from Singer (1962b).

The genus is reported from Brazil and Uruguay (Singer 1962b, He et al. 2019). No molecular data is available for this genus (He et al. 2019). The taxonomic classification of *Brauniella* is placed under *Strophariaceae, Agaricineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota* in Species Fungorum, MycoBank, UNITE, and Hyde et al. (2024a); however, GenBank, places it under *Gomphidiaceae* and it may require an update.

Synonymy: *Braunia* Rick

Type species: *Brauniella alba* (Rick) Rick ex Singer

Basionym: *Braunia alba* Rick

Leratiomyces Bresinsky & Manfr. Binder ex Bridge, Spooner, Beever & D.C. Park, Mycotaxon 103, 115

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 24

Classification: *Strophariaceae, Agaricineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Leratiomyces is a revised and valid genus name proposed to replace the illegitimate genus *Leratia* Pat. ex Sacc. & Trotter (Bresinsky & Binder 1998). Initially, four species were transferred into *Leratiomyces*, forming new combinations: *L. atrovirens* Bresinsky & Manfr. Binder, *L. coccineus* (Massee & Wakef.) Bresinsky & Manfr. Binder, *L. similis* Bresinsky & Manfr. Binder, and *L. smaragdinus* Pat. ex Bresinsky & Manfr. Binder, with some of them originally collected from New Caledonia (Bresinsky & Binder 1998, Halama & Gorka 2019). Later, six additional species from closely related genera were incorporated into the genus as new combinations: *L. ceres* (Cooke & Massee) Spooner & Bridge, *L. cucullatus* (Shope & Seaver) Beever & D.C. Park, *L. erythrocephalus* (Tul. & C. Tul.) Beever & D.C. Park, *L. magnivelaris* (Peck) Bridge & Spooner, *L. percevalii* (Berk. & Broome) Bridge & Spooner, and *L. squamosus* (Pers.) Bridge & Spooner (Bridge et al. 2008). Currently, the genus is distributed across tropical and temperate regions, typically growing saprophytically on soil, decomposing wood chips, and dry grasslands (Bridge et al. 2008, Halama & Gorka 2019).

Morphologically, species of *Leratiomyces* exhibit lignicolous basidiomata with lamellate or secotioid forms, ranging from hymenogastriod to agaricoid types (Bridge et al. 2008). The basidiomata are usually stipitate and rarely sessile. The pileus is sub-globose to pyriform, sometimes convex to umbonate, with colouration from yellow to red, and may appear smooth or scaly. Basidiospores are pale to dark brown, ovate to ellipsoid, smooth-walled, and bear a germ pore (Bridge et al. 2008).

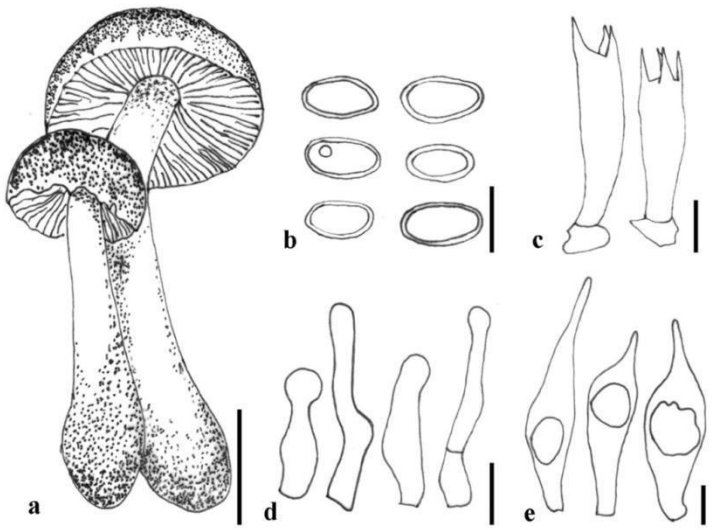


Fig. 24 – ***Leratiomyces ceres*** (MH-2018-1847). a Basidiomata. b Basidiospores. c Basidia. d Cheiloleptocystidia. d Pleurochrysocystidia. Scale bars: a = 1 cm, b–e = 10 µm. Redrawn from Halama & Gorka (2019). For original basidiomata, refer to Halama & Gorka (2019).

Although most species in the genus are based on taxonomic recombination, a few have been collected and described more recently (Bresinsky & Binder 1998, Bridge et al. 2008, Halama & Gorka 2019). For example, *L. squamosus*, *L. laetissimus*, and *L. ceres* were described from Poland, with the first two species found in fertile lowland beech forests, and *L. ceres* collected from soil mixed with wood chips in urban shrubbery mulch (Halama & Gorka 2019). *L. ceres*, originally reported from Australia and New Zealand, has now spread across Europe, South Africa, and both

South and North America, and is commonly known as a woodchip mulch fungus (Halama & Gorka 2019). *Leratiomyces erythrocephalus* was reported from wood chips in flower beds on the grounds of Lincoln University, New Zealand (Cooper 2012), and *L. percevalii* was recently recorded from Hakkâri Province, Turkey, growing on wood chips, in addition to previously reported *L. squamosus* (Acar et al. 2021). Within *Leratiomyces,* Species Fungorum (2026) comprises 11 recognised species worldwide. To refine the phylogeny and taxonomy of the genus, additional molecular markers, particularly protein-coding genes, are needed to support a comprehensive taxonomic revision. The classification of *Leratiomyces* in *Strophariaceae, Agaricineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota,* is in agreement in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Synonyms: *Cytophyllopsis* R. Heim, *Le-ratia* Pat., *Le-ratia* Pat. ex Sacc. & Trotter, *Leratiomyces* Bresinsky & Manfr. Binder

Type species: *Leratiomyces similis* (Pat. ex Sacc. & Trotter) Bresinsky & Manfr. Binder ex Redhead & McNeill

Basionym: *Le-ratia similis* Pat. ex Sacc. & Trotter

Other accepted species: (Species Fungorum – search *Leratiomyces*)

Clavariineae Olariaga, Huhtinen, Læssøe, J.H. Petersen & K. Hansen

Species Fungorum, Facesoffungi, MycoBank, GenBank

Clavariaceae Chevall., Flore Générale des Environs de Paris 1, 102

Species Fungorum, Facesoffungi, MycoBank, GenBank

Classification: *Clavariineae, Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Clavariaceae was established by F.F. Chevallier with the type genus *Clavaria* Vaill. ex L. (Chevallier 1826). *Clavariaceae* consists of the 10 genera: *Camarophyllopsis* Herink, *Clavaria* Vaill. ex L., *Clavicorona* Doty, *Clavulinopsis* Overeem, *Hirticlavula* J.H. Petersen & Læssøe, *Hodophilus* R. Heim, *Hyphodontiella* Å. Strid, *Lamelloclavaria* Birkebak & Adamčík, *Mucronella* Fr., and *Ramariopsis* (Donk) Corner (Hyde et al. 2024a). *Clavariaceae* comprise approximately 110 recognised species worldwide and are distributed mostly in temperate regions, some in tropical and subtropical regions (Corner 1950, Birkebak et al. 2013, Furtado et al. 2016). Members of the family are characterised by clavate, coralloid, resupinate, pendent-hydnoid, and hygrophoroid type basidiomata (Hibbett & Thorn 2001, Birkebak et al. 2013, Furtado et al. 2016).

Camarophyllopsis Herink, Sborník Severočeského Musea, Historia Naturalis 1, 61

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 25

Classification: *Clavariaceae, Clavariineae, Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Camarophyllopsis was established by Herink in 1958, typified by *C. schulzeri* (Young & Wood 1997). Members of *Camarophyllopsis* are solitary to sub-gregarious, terrestrial, biotrophic and saprobic, and distributed globally (Young & Wood 1997, He et al. 2019). *Camarophyllopsis* was first classified under *Hygrophoraceae* Lotsy (Hesler & Smith 1963, Arnolds 1986). Later, Matheny et al. (2006) transferred it to *Clavariaceae* Chevall. Species within *Camarophyllopsis* are polyphyletic and are categorised into two clades: *C.* subgen. *Camarophyllopsis* Herink and *C.* subgen. *Hodophilus* (R. Heim) Bon.

The basidiomata of *Camarophyllopsis* are agaricoid, characterised by thin to fleshy, grey to ochre or brown, convex to umbilicate, and hygrophanous pileus (Young & Wood 1997, Zhang et al. 2019). Lamella are distant and broadly adnate to arcuate or decurrent (Young & Wood 1997). The stipe is dry, often marked with small dots or pruinose punctate, and lacks a veil. Basidia are narrowly clavate, typically four-spored (Young & Wood 1997). Basidiospores are subglobose to broadly ellipsoidal, hyaline, smooth, inamyloid, and white in deposit (Young & Wood 1997, Zhang

et al. 2019). The pileipellis consists of erect, ascending, or repent, subcylindrical to ellipsoidal terminal cells (Arnolds 1986). Cystidia are either absent or inconspicuous. Clamp connections may be present or absent (Young & Wood 1997).

Species delineation within *Camarophyllopsis* used morphological and phylogenetic analysis (ITS and LSU) (Zhang et al. 2019). Within *Camarophyllopsis*, Species Fungorum (2026) has recognised approximately 16 species worldwide. *Camarophyllopsis* can be distinguished from its phylogenetically related clades, *Hodophilus* R. Heim and *Lamelloclavaria* Birkebak & Adamčík, by its pileipellis structure, which is composed of chains of erect, ascending, or repent, subcylindrical to ellipsoid end cells and lacks inflated terminal elements (Birkebak et al. 2016). The classification of *Camarophyllopsis* in *Clavariaceae, Clavariineae, Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota* is in agreement in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Synonymy: *Hygrotrama* Singer

Type species: *Camarophyllopsis schulzeri* (Bres.) Herin

Basionym: *Hygrophorus schulzeri* Bres

Other accepted species: (Species Fungorum – search *Camarophyllopsis*)

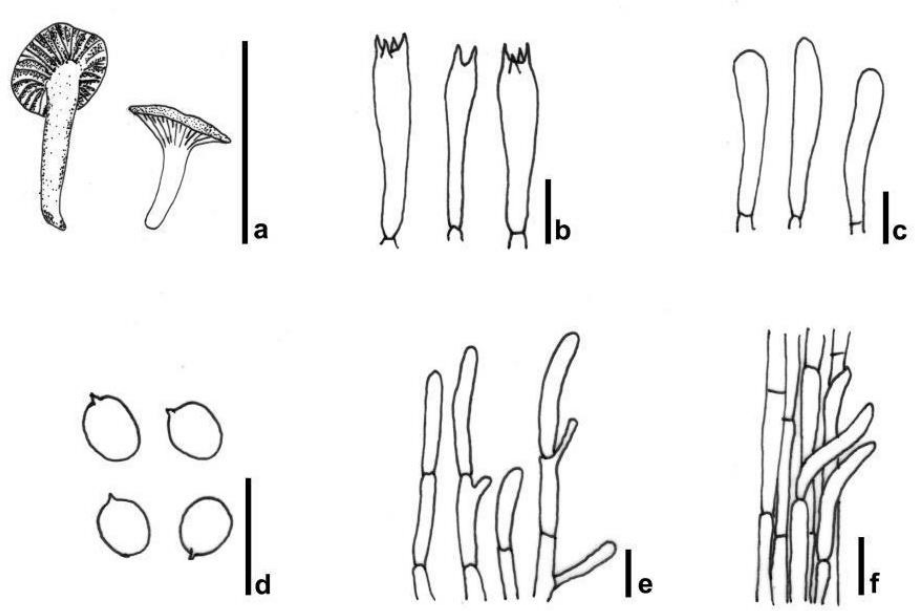


Fig. 25 – ***Camarophyllopsis olivaceogrisea*** (GDGM44519, holotype). a Basidiomata. b Basidia. c Basidioles. d Basidiospores. e Hyphal terminations in pileipellis. f Stipitipellis. Scale bar: a = 2 cm, b–d = 10 µm, e–f = 20 µm. Redrawn from Zhang et al. (2019). See Wikipedia, English Fungi and Fungus Gallery for images of fruiting bodies.

Clavicorona Doty, Lloydia 10, 38

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 26

Classification: *Clavariaceae, Clavariineae, Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota*, *Fungi*

In 1947, Maxwell Stanford Doty described *Clavicorona*, including *C. pyxidata*, *C. cristata*, *C. taxophila*, and *C. candelabrum* (Doty 1947). *Clavicorona* usually grows on decaying wood, contributing to the breakdown of organic matter within forest ecosystems (Dodd 1972). These saprotrophic fungi are primarily found in temperate and subtropical regions, although certain species have also been observed in tropical areas, including parts of Europe and North America, such as France and Spain (Olariaga et al. 2015, Requejo et al. 2024).

Clavicorona species are characterised by erect, repeatedly branched, coral-like basidiomata with cylindrical to club-shaped branches that arise from a common base (Requejo et al. 2024). The

basidiomata vary in size from small to large, with smooth to slightly velvety texture, sometimes with slight wrinkles or grooves along the branches. The stipe is usually elongated and slender, while the branches are primarily cylindrical but may taper toward the ends, exhibiting either irregular or sympodial growth patterns (Birkebak et al. 2016). Microscopically, some basidiomata may have cystidia on their surface, while others lack them. Basidia are club-shaped and typically bear four basidiospores. Basidiospores are globose or ellipsoid, smooth, small, and hyaline or light-coloured (Dodd 1972, Birkebak et al. 2016). Although traditionally distinct within *Clavariaceae*, *Clavicorona* has long been confused with *Artomyces* Jülich due to their coral-like basidiomata (Dodd 1972). Molecular data (Birkebak et al. 2016, Requejo et al. 2024) confirm its placement in *Clavariaceae*, but its generic limits remain blurred, as branching forms overlap with *Clavaria* and *Artomyces.* Under *Clavicorona*, Species Fungorum (2026) has recognised only 8 species worldwide.

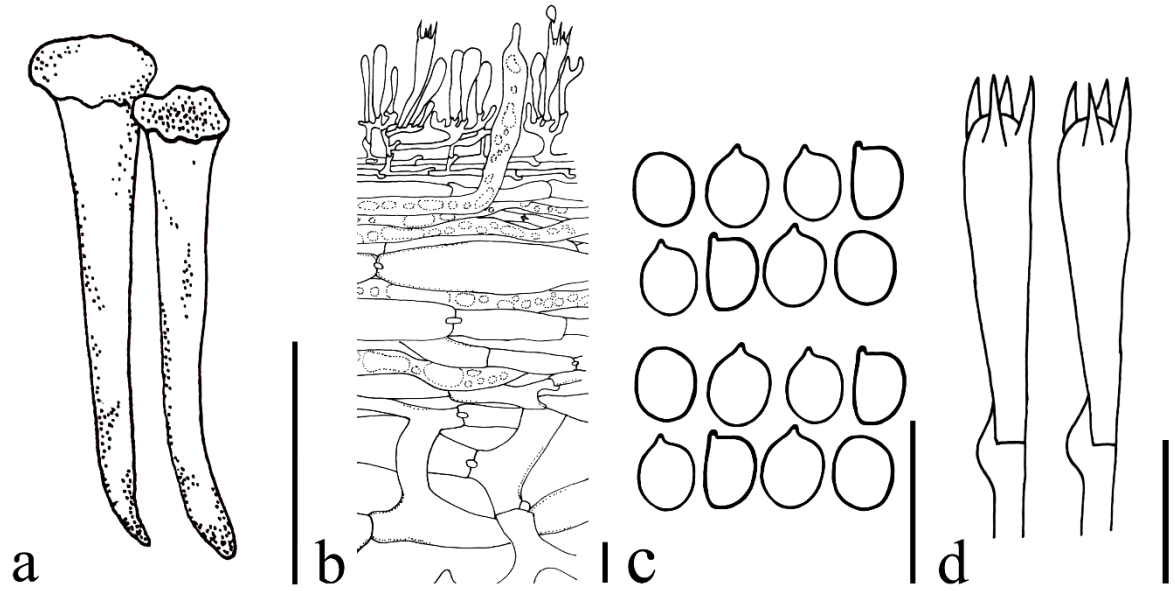


Fig. 26 – ***Clavicorona*** sp. a Basidiomata. b Basidiospores. c Basidia. d Longitudinal section with hymenium, subhymenium, and context. Scale bars: a = 1 cm, b–d = 10 µm. Redrawn from Dodd (1972). For original basidiomata, refer to Birkebak et al. (2016) Yew Club or Wikipedia.

Molecular phylogenetic analyses (ITS, LSU, and *rpb2*) indicate that *Clavicorona* is closely related to *Clavariaceae*, which includes the genus *Clavaria* and *Camarophyllopsis* (Birkebak et al. 2016, Requejo et al. 2024). While its close relatives may have simpler or more complex structures and varying ecological preferences, *Clavicorona* is distinguished by its typically smaller, highly branching basidiomata found on decaying wood (Dodd 1972). The main differences between *Clavicorona* and other genera, such as *Clavaria*, *Ramaria*, and *Artomyces*, are found in their basidiomata structure, preferred habitats, and colourations (Dodd 1972). Currently, *Clavicorona* is not recognised for commercial or medicinal applications (Purhonen 2018). However, there is always potential for further discoveries regarding their biotechnological or medicinal properties (Zheng & Shen 2009). The taxonomic classification of *Clavicorona* is placed under *Clavariaceae* in Species Fungorum, MycoBank, UNITE, and Hyde et al. (2024a); however, GenBank places it under *Tricholomataceae* and it may require an update.

Type species: *Clavicorona taxophila* (Thom) Doty

Basionym: *Craterellus taxophilus* Thom

Other accepted species:

C. amazonensis Corner

C. angustispora O. Requejo, M.L. Castro, G. Corriol & Justo

C. brunnea Corner

C. geoglossoides Corner
C. gracilis (Corner) Corner
C. mairei (Batetta) Corner
C. subechinulata Gardezi

Hodophilus R. Heim, Champignons d'Europe 2
Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 27
Classification: *Clavariaceae, Clavariineae, Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Hodophilus is an agaricoid genus established by R. Heim and *H. foetens* (W. Phillips) Birkebak & Adamcik as the type species (Birkebak et al. 2016). Initially, *Clavariaceae* included only clavarioid fungi (Singer 1975). However, recent phylogenetic studies have expanded the family to include some agaricoid genera (Birkebak et al. 2013, 2016). Members of *Hodophilus* are characterised by having a hymeniderm pileipellis composed of typically perpendicular, globose, broadly inflated, and obpyriform to sphaero-pendunculate terminal elements, subglobose to broadly ellipsoid, hyaline, smooth, thin-walled basidiospores, and clamp connections absent in all tissues (Birkebak et al. 2016). Under *Hodophilus*, Species Fungorum (2026) has recognised 31 species worldwide. The genus is primarily distributed in temperate regions of Europe and the Americas (Adamčík et al. 2016, 2017a, b, 2018, 2020). Nevertheless, some species have been reported from tropical or subtropical areas, including *H. indicus* K. N. A. Raj, K. P. D. Latha & Manim. from India (Crous et al. 2017), *H. glabripes* Ming Zhang, C.Q. Wang & T.H. Li (Zhang et al. 2019), and *H. pseudoglabripes* S. M. Tang & S.H. Li from China (Tang et al. 2023).

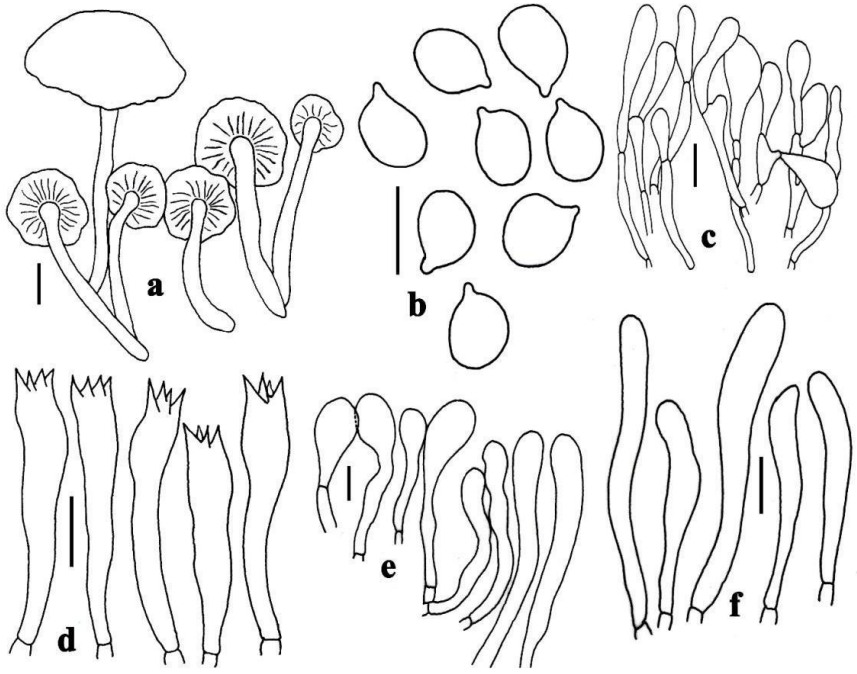


Fig. 27 – ***Hodophilus foetens***. a Basidiomata of *H. foetens*. b Basidiospores. c Caulocystidia. d Basidia. e Hyphal terminations in pileipellis. f Basidioles. Scale bars: a = 1 cm, b–f = 10 μm. Redrawn from Adamčík et al. (2017a). For original basidiomata, please refer to Adamčík et al. (2017a) or Wikipedia.

Based on morphological characteristics and phylogenetic data, Adamčík et al. (2020) proposed to split *Hodophilus* into three sections: *H.* sect. *Phaeophylli* (basidiomata pale or dark brown, without distinct naphthalene odours, without yellow colour and dark dots on the stipe), *H.* sect. *Hodophilus* (distinct naphodours), and *H.* sect. *Micacei*. Adamčík et al. (2017a, 2018) and

Birkebak et al. (2016) used nucleotide sequences of ITS and LSU regions to study the phylogenetic relationships within the genus *Hodophilus*.

Hodophilus foetens (W. Phillips) Birkebak & Adamcík is characterised by its unpleasant camphor-like odour together with skatol and methylmercaptan-like components, which persists for several years even in dried herbarium specimens (Arnolds 1990). Based on its phylogenetic position, it has been recently transferred from *Camarophyllopsis* Herink to *Hodophilus* (Birkebak et al. 2016). Members of both genera had been previously treated within *Hygrophorus* Fr. (Dennis 1953a, Singer 1959a, Hesler & Smith 1963). The classification of *Hodophilus* in *Clavariaceae, Clavariineae, Agaricales, Agaricomycetidae, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* is in agreement in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Type species: *Hodophilus foetens* (W. Phillips) R. Heim

Basionym: *Hygrophorus foetens* W. Phillips

Other accepted species: (Species Fungorum – search *Hodophilus*)

Ramariopsis (Donk) Corner, Monograph of *Clavaria* and allied Genera (Annals of Botany Memoirs No. 1), 636, 700

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 28

Classification: *Clavariaceae, Clavariineae, Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Ramariopsis was described by Donk in 1933 as *Clavaria* subgen. *Ramariopsis* Donk, with type species *Clavaria kunzei* Fr. (García-Sandoval et al. 2005). Corner (1950) elevated subgenus *Ramariopsis* to the genus level, maintaining *Clavaria kunzei* [= *Ramariopsis kunzei* (Fr.) Corner] as the type species. Over time, classification within *Ramariopsis* has evolved. Petersen (1966) proposed dividing *Ramariopsis* into two subgenera: *Laevispora* for species with smooth basidiospores, and *Ramariopsis* for those with echinulate basidiospores (García-Sandoval et al. 2005). Petersen (1978) proposed a new classification for the closely related genera *Ramariopsis*, *Clavulinopsis* Overeem, and *Clavaria* Vaill. Ex. L.

The basidiomata of *Ramariopsis* are characterised by being small to medium-sized, branched or rarely simple, with a distinct stipe and usually slender, cylindrical branches (Corner 1950, 1970, Hyde et al. 2016, Halama et al. 2017). Basidiospores are ellipsoid or subglobose, hyaline, and display finely verruculose to echinulate ornamentation (Corner 1950, 1970, Hyde et al. 2016). Both basidia and tramal hyphae have clamp connections at their base (Corner 1950, 1970, Hyde et al. 2016, Halama et al. 2017).

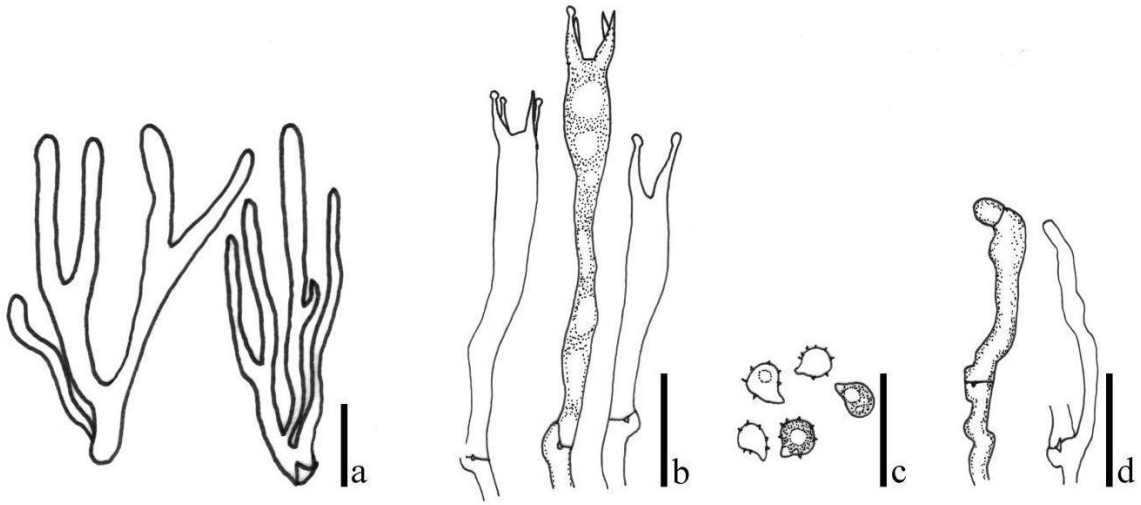


Fig. 28 – ***Ramariopsis tenuiramosa***. a Basidiomata. b Basidia. c Basidiospores. d Sterile elements of the hymenium. Scale bar: a = 0.5 cm, b–d = 15 μm. Redrawn from Petersen (1964).

Phylogenetic studies based on the LSU show the monophyly of *Ramariopsis* species with ornamented basidiospores and clamps in the trama and branched basidiomata (including *R. kunzei*), while also showing paraphyletic lineages with remaining taxa that include smooth basidiospores (Kautmanová et al. 2012, Halama et al. 2017). Morphologically, species of *Ramariopsis* are similar to *Clavulinopsis* Overeem but can be distinguished by their echinulate basidiospores (Halama et al. 2017). Under *Ramariopsis*, Species Fungorum (2026) have listed approximately 48 species worldwide. *Ramariopsis* species are terrestrial, saprotrophic, sometimes lignicolous, and can be solitary or gregarious (Corner 1950, 1970, Petersen 1978, Hyde et al. 2016). The classification of*Ramariopsis* in *Clavariaceae, Clavariineae, Agaricales, Agaricomycetidae, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* is in agreement in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Synonymy: *Clavaria* subgen. *Ramariopsis* Donk

Type species: *Ramariopsis kunzei* (Fr.) Corner

Other accepted species: (Species Fungorum – search *Ramariopsis*)

Hygrophorineae Aime, Dentinger & Gaya

Species Fungorum, Facesoffungi, MycoBank, GenBank

Cantharellulaceae (Lodge, Redhead & Desjardin) Vizzini, Consiglio & P. Alvarado, Vizzini, Alvarado, Consiglio, Marchetti & Xu, Studies in Mycology 107, 89

Species Fungorum, Facesoffungi, MycoBank, GenBank

Classification: *Hygrophorineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Cantharellulaceae, erected by Vizzini and collaborators, represents a newly recognized lineage comprising two genera, *Cantharellula* Singer and *Pseudoarmillariella* Singer (Vizzini et al. 2024). Members of this family are morphologically characterized by clitocyboid to omphalinoid basidiomata, with convex, depressed, or infundibuliform pileus and decurrent lamellae. Repeatedly forked lamellae are reddish brown, and the stipe is central to eccentric. The hymenophoral trama is partly gelatinized at the lamellar edge and is tridirectional, forming a weak hymenial palisade. Basidia bear basal clamp connections and are approximately four times the length of the basidiospores. Basidiospores are smooth, hyaline, distinctly amyloid, acyanophilous, and typically at least twice as long as wide. Cheilocystidia and pleurocystidia are absent, and the pileipellis consists of hyphae with cytoplasmic pigments, with or without encrusting pigments. Members are bryophilous or lignicolous and lack L-DOPA betalains and carotenoid pigments (Vizzini et al. 2024). Earlier studies placed *Pseudoarmillariella* within *Hygrophoraceae*, whereas *Cantharellula* was not previously recognized (Wijayawardene et al. 2020). Moncalvo et al. (2002) presented molecular data confirming the sister-group relationship between these genera. Subsequent recognition of their autapomorphic morphological characters and discrete phylogenetic placement within the suborder *Hygrophorineae* led to their formal elevation to family rank (Vizzini et al. 2024).

Cantharellula Singer, Revue de Mycologie 1(6), 281

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 29

Classification: *Cantharellulaceae, Hygrophorineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Cantharellula was established by Rolf Singer in 1936, with *C. umbonata* as its type species (Singer 1938). These fungi are gregarious and form ectomycorrhizal associations, primarily with bryophytes (Singer 1938, Lawrey et al. 2009, Lodge et al. 2014). Species of *Cantharellula* are distributed globally, mainly in temperate regions (He et al. 2019). Species Fungorum (2025) has listed seven species worldwide. The classification of *Cantharellula* in MycoBank and Hyde et al. (2024a) is under *Cantharellulaceae*, whereas Species Fungorum, GenBank, and UNITE list it under *Hygrophoraceae* and may need updating.

Cantharellula is characterised by clitocyboid basidiomata, which feature a convex, indented, or infundibuliform, opaque pileus (Lodge et al. 2014). The surface of the pileus and stipe is typically yellowish or greyish brown. The lamellae are decurrent, frequently forked, and often turn reddish-brown when stained. The stipe is either fleshy or fleshy-fibrous. Basidiospores are smooth, hyaline, cylindrical or ellipsoid-oblong, amyloid, acyanophilic, and produce a white deposit. The basidia are four times longer than the basidiospores, and both cheilocystidia and pleurocystidia are absent. The lamellar trama is sub-gelatinised at the edge, featuring a subregular central strand, tridirectional lateral strands, and hyphae that are interwoven with vertically oriented hyphae and others that diverge perpendicularly from the vertical ones. The subhymenium consists of short or long-celled, mostly parallel hyphal segments aligned with the basidia. Clamp connections are present (Lodge et al. 2014).

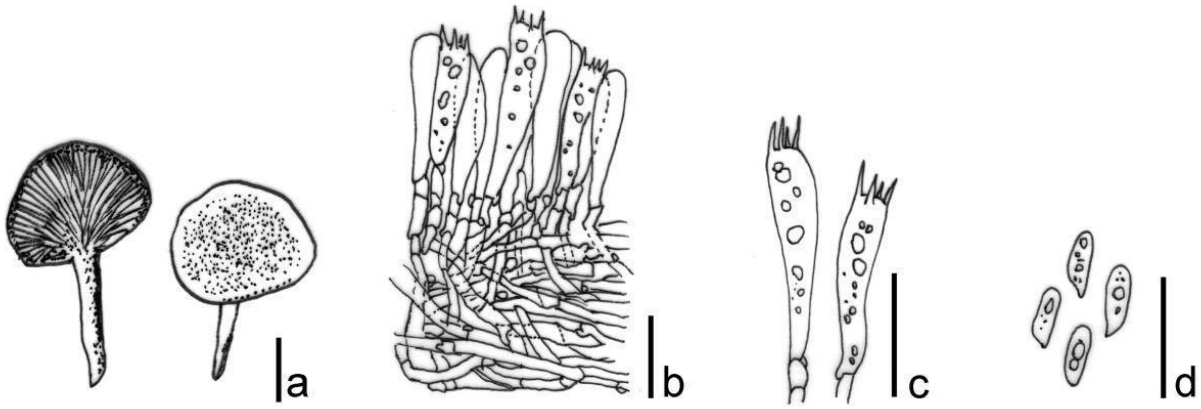


Fig. 29 – ***Cantharellula umbonata*** (RDY-1366). a. Basidiomata. b Cross-section of lamella. c Basidia. d Basidiospores. Scale bar: a = 1 cm, b–d = 20 µm. Redrawn from Lodge et al. (2014).

In addition to the morphological traits, phylogenetic analyses (ITS, LSU, SSU, and *rpb2*) result in strong support for *Cantharellula* as a sister clade to *Pseudoarillariella* (Singer) Singer (Lodge et al. 2014). Morphologically, both genera share long, smooth amyloid basidiospores and tridirectional lamellar trama. However, *Cantharellula* is distinct from *Pseudoarillariella* in its amyloid spore reaction and the presence of clamp connections (Lodge et al. 2014).

Type species: *Cantharellula umbonata* (J.F. Gmel.) Singer

Basionym: *Merulius umbonatus* J.F. Gmel.

Other accepted species:

C. alpina G. Stev.
C. coprophila (Speg.) Singer
C. felleoides (Kauffman) Singer
C. infundibuliformis Singer
C. oregonensis (Murill) Singer
C. waiporiensis (G. Stev.) E. Horak

Pseudoarmillariella (Singer) Singer, Mycologia 48(5), 725

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 30

Classification: *Cantharellulaceae, Hygrophorineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Pseudoarmillariella was established by R. Singer, with *P. ectypoides* as its type species (Singer 1956). The classification of this genus remained unclear until Norvell et al. (1994) and Redhead et al. (2002) clarified its genetic boundaries. Subsequent phylogenetic studies confirmed its placement within *Hygrophoraceae* (Matheny et al. 2006, Lawrey et al. 2009, Yang et al. 2013).

Lodge et al. (2014) revised the genus to include species characterised by tri-directional lamellar trama and an incipient pachypodial hymenial palisade. Members of this genus are lignicolous and are found across North and Central America and Asia, including the USA, New Zealand, and China (Horak 1971, Singer 1986, Kirk et al. 2008, Yang et al. 2013, Lodge et al. 2014). The classification of *Pseudoarmillariella* in MycoBank, Hyde et al. (2024a), and Vizzini et al. (2024) is under *Cantharellulaceae*, whereas Species Fungorum and UNITE list it under *Hygrophoraceae* and may need updating. The genus consists of three species worldwide (Hyde et al. 2024a, Vizzini et al. 2024).

Pseudoarmillariella is characterised by omphalinoid basidiomata with a deeply infundibuliform, opaque pileus and a yellowish or greyish brown, appressed-fibrillose stipe surface (Lodge et al. 2014). The lamellae are decurrent, repeatedly forked, and exhibit a deep ochraceous or yellowish clay colouration. The stipe is either central or eccentric. Basidiospores are smooth, hyaline, amyloid, and acyanophilic, and appear white in deposit. Both cheilocystidia and pleurocystidia are absent. The pileipellis hyphae are nodulose-encrusted, while the lamellar trama is sub-gelatinised at the lamellar edge with a sub-regular central strand toward the pileus and adjacent pileus context. The lamellar context features tridirectional strands, with some hyphae parallel to the lamellar edge and others diverging more or less perpendicularly from the vertical hyphae. Clamp connections are also present (Lodge et al. 2014).

Yang et al. (2013) described a new species, *Pseudoarmillariella bacillaris,* from China based on morphological characteristics and phylogenetic analyses (ITS and LSU). Morphologically, this genus resembles *Cantharellula* Singer and *Chrysomphalina* Clémençon (Lodge et al. 2014). However, *Cantharellula* is distinguished by the presence of encrusting pigments on the cuticular hyphae and the presence of bright ochraceous pigments in the hymenium (Lodge et al. 2014). Similarly, *Chrysomphalina* differs from *Pseudoarmillariella* due to the amyloid reaction of its basidiospores and the presence of encrusting pigments on the cuticular hyphae (Lodge et al. 2014). These genera are placed in *Cantharellulaceae* and *Hygrocybaceae,* respectively, based on molecular data (Hyde et al. 2024).

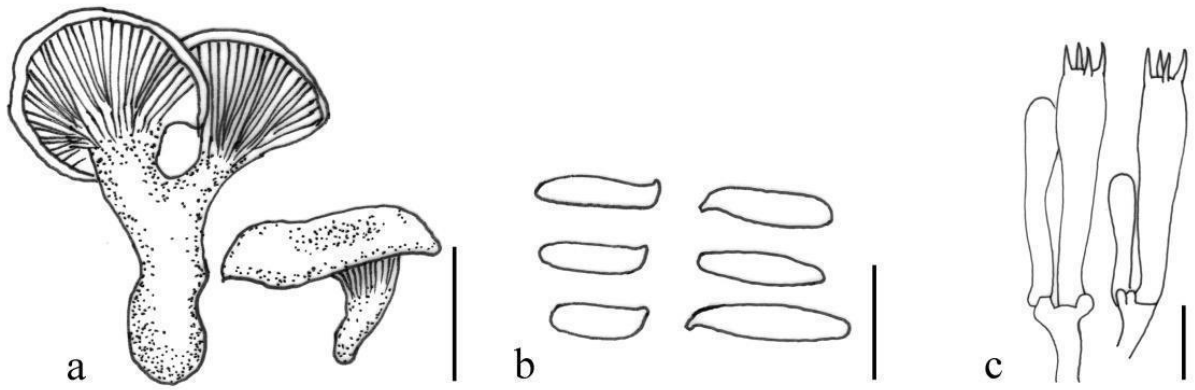


Fig. 30 – ***Pseudoarmillariella bacillaris*** (HKAS 76377, holotype). a Basidiomata. b Basidiospores. c Basidia and basidioles. Scale bar: a = 2 cm, b–c = 10 µm. Redrawn from Yang et al. (2013). For original basidiomata, refer to Yang et al. (2013).

Synonymy: *Cantharellula* subgen. *Pseudoarmillariella* Singer
Type species: *P. ectypoides* (Peck) Singer
Basionym: *Agaricus ectypoides* Peck
Other accepted species:
P. bacillaris Zhu L. Yang, B. Feng & Y.J. Hao
P. fistulosa (G. Stev.) E. Horak

Cuphophyllaceae (Z.M. He & Zhu L. Yang) Vizzini, Consiglio & P. Alvarado, in Vizzini, Alvarado, Consiglio, Marchetti & Xu, Studies in Mycology 107, 90

Species Fungorum, Facesoffungi, MycoBank

Classification: *Hygrophorineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Based on recent morpho-molecular evidence, *Cuphophyllaceae* has been recognised with a revised taxonomic status (Vizzini et al. 2024). Members of this family are predominantly terricolous and saprobic, growing on dead and decaying plant material (Vizzini et al. 2024). Currently, *Cuphophyllaceae* comprises five genera, viz. *Ampulloclitocybe* Redhead, Lutzoni, Moncalvo & Vilgalys, *Cantharocybe* H.E. Bigelow & A.H. Sm., *Cuphophyllus* (Donk) Bon, *Hygrophorocybe* Vizzini & Contu, and *Spodocybe* Z.M. He & Zhu L. Yang, and most species are widely distributed across tropical and temperate regions (Hyde et al. 2024a, Vizzini et al. 2024). Notably, *Cuphophyllus virgineus* has been reported as a root endophyte of *Plantago lanceolata*, transmitted vertically (Vizzini et al. 2024). Morphologically, *Cuphophyllaceae* is characterized by basidiomata that are mostly clitocyboid, rarely omphalinoid or mycenoid, with a convex to funnel-shaped pileus (Vizzini et al. 2024). The pileus surface is usually dry and smooth, occasionally lubricous or rarely viscid. Lamellae are decurrent to long-decurrent, veils are absent, and basidiospores are ellipsoid to subglobose, thin-walled, smooth, cyanophilous or non-cyanophilous, and inamyloid. The pileipellis is typically a cutis, sometimes an ixocutis or trichoderm. The hymenophoral trama is regular to bidirectional, clamp connections are usually present, and L-DOPA betalains and carotenoid pigments are absent (Vizzini et al. 2024). Although most species are saprotrophic, a few exhibit biotrophic behaviour (Vizzini et al. 2024). Except *Spodocybe*, all genera were previously placed in *Hygrophoraceae* (Wijayawardene et al. 2020) and were later transferred to *Cuphophyllaceae* based on phylogenetic evidence (Hyde et al. 2024a, Vizzini et al. 2024). The type genus *Cuphophyllus* is the most species-rich, comprising over 30 species worldwide, while the remaining genera include fewer than 10 species. Nearly all species in *Cuphophyllaceae* are supported by molecular data.

Cuphophyllus (Donk) Bon, Documents Mycologiques 14(56), 10

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 31

Classification: *Cuphophyllaceae, Hygrophorineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Cuphophyllus is a genus within *Hygrophoraceae*, with *C. pratensis* (Pers.) Bon as the type species (Boertmann 2010, Lodge et al. 2014). It was originally established as *Hygrocybe* subgen. *Cuphophyllus* by Donk (1962), but was elevated to genus rank by Bon (1985).

Members of *Cuphophyllus* are characterised by clitocyboid basidiomata, decurrent lamellae, and a stout stipe that is solid or hollow near the apex. They possess smooth, inamyloid basidiospores that are ellipsoid, subglobose, or globose, often guttulate in KOH. Their cap epidermis features a highly interwoven mycelium or, occasionally, a regular to subregular central strand. Additionally, they have long basidia with basal clamp connections and lack cystidia (Lodge et al. 2014, Voitk et al. 2020). Within *Cuphophyllus,* Species Fungorum (2026) lists 52 species worldwide. The species in this genus are saprobic, commonly associated with forests and grasslands, and often grow on acidic, humus-rich soils (Griffith et al. 2002, Voitk et al. 2020).

Hygrophoraceae, the family of waxcap fungi, primarily includes species of *Hygrocybe* (Fr.) P. Kumm. (Griffith et al. 2002). Phylogenetic reassessment of *Hygrophoraceae* by Lodge et al. (2014) confirmed that *Cuphophyllus* forms a monophyletic group within the family. Additionally, Lodge et al. (2014) proposed the division of *Cuphophyllus* into six sections: *Adonidi*, *Cuphophyllus*, *Fornicati*, *Virginei*, and two unnamed sections.

Further phylogenetic studies using multiple gene sequences (ITS, LSU, and *rpb2*) placed *Cuphophyllus* along with *Ampulloclitocybe* Redhead, Lutzoni, Moncalvo & Vilgalys, *Cantharocybe* H.E. Bigelow & A.H. Sm., and *Spodocybe* Z.M. He & Zhu L. Yang in the subfamily

Cuphophylloideae (He & Yang 2021). Meanwhile, Vizzini et al. (2024), based on a six-gene phylogeny, proposed the new family *Cuphophyllaceae* to accommodate *Hygrophorocybe*.

Voitk et al. (2020) described two novel species of *Cuphophyllus* and reclassified *Hygrophorus pseudopallidus* Hesler & A.H. Sm. to *Cuphophyllus* based on ITS analysis of the holotype. Further, Ye et al. (2025) described a new species (*Cuphophyllus lijiangensis* L. Ye) from Yunnan province, China, based on morphological and phylogenetic studies. The classification of *Cuphophyllus* in Species Fungorum, MycoBank and Hyde et al. (2024a) is under *Cuphophyllaceae*, whereas GenBank and UNITE list it under *Hygrophoraceae* and may need updating.

Synonyms: *Dermolomopsis* Vizzini, *Hygrocybe* subgen. *Cuphophyllus* Donk

Type species: *Cuphophyllus pratensis* (Pers.) Bon,

Basionym: *Agaricus pratensis* Pers.

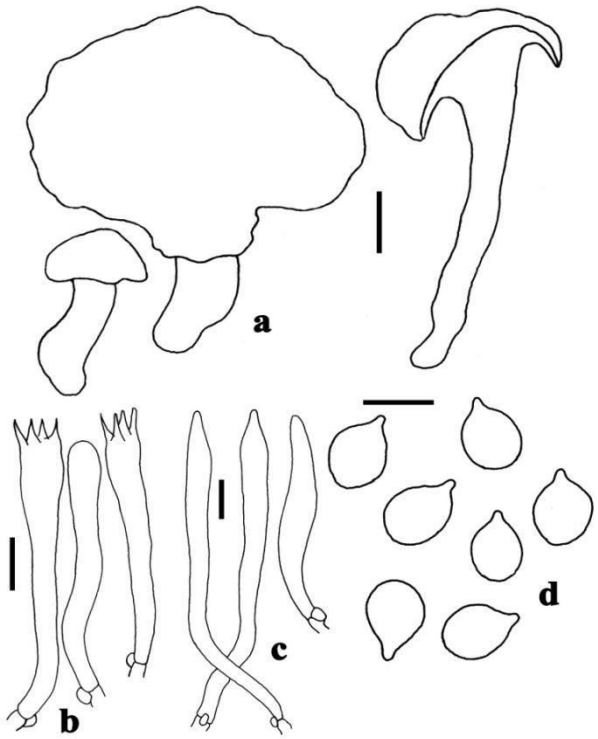


Fig. 31 – ***Cuphophyllus pratensis***. a Basidiomata. b Basidia and basidiole. c Pileipellis terminal cells. d Basidiospores. Scale bars: a = 10mm, b–d = 10 µm. Redrawn from Desjardin & Perry (2020).

Hygrocybaceae (Padamsee & Lodge) Vizzini, Consiglio & P. Alvarado, in Vizzini, Alvarado, Consiglio, Marchetti & Xu, Studies in Mycology 107, 88

Species Fungorum, Facesoffungi, MycoBank

Classification: *Hygrophorineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Hygrocybaceae was established by elevating *Hygrophoraceae* subfamily *Hygrocyboideae* Padamsee & Lodge to family rank and is typified by *Hygrocybe* (Fr.) P. Kumm (Vizzini et al. 2024). The family currently comprises nine genera: *Chromosera* Redhead, Ammirati & Norvell, *Chrysomphalina* Clémençon, *Gliophorus* Herink, *Gloioxanthomyces* Lodge, Vizzini, Ercole & Boertm., *Humidicutis* (Singer) Singer, *Hygrocybe*, *Neohygrocybe* Herink, *Porpolomopsis* Bresinsky, and *Sinohygrocybe* C.Q. Wang, Ming Zhang & T.H. Li (Vizzini et al. 2024). *Hygrocybaceae* is characterized by bright coloured basidiomata with thick, waxy lamellae, absence of true veils, thin-walled, guttulate, hyaline basidiospores that are smooth-walled or bear conical spines, lack of amyloid reactions and generally acyanophilous; absence of pleurocystidia and true cheilocystidia; non-hymeniform pileipellis; inamyloid and regular to subregular hymenophoral

trama; typically, carotenoids or muscaflavin pigmented (Vizzini et al. 2024). Members of *Hygrocybaceae* are terrestrial, rarely occurring on woody or arboreal substrates, and are frequently associated with mosses in grassland and forest ecosystems (Vizzini et al. 2024). They are considered to exhibit a possibly biotrophic lifestyle, although ectomycorrhizal associations with woody plants have not been reported (Seitzman et al. 2011, Vizzini et al. 2024).

Chrysomphalina Clémençon, Zeitschrift für Mykologie 48(2), 202

Species Fungorum, Facesoffungi, MycoBank Fig. 32

Classification: *Hygrocybaceae, Hygrophorineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota*, *Fungi*

Chrysomphalina was introduced and classified as an omphalinoid genus under *Tricholomataceae* R. Heim ex Pouzar (Clémençon 1982). Clémençon (1982) grouped all European omphalinoid species characterised by smooth-surfaced, inamyloid basidiospores into various genera under *Tricholomataceae*, including *Chrysomphalina*. It is characterised by its submembranous, funnel-shaped grey to yellowish brown pileus with pale to rich yellow, decurrent lamellae bearing ochre to orange-yellowish spore print (Clémençon 1982). Microscopically, the intracellular pigmentation, pachypodial lamellar trama, ellipsoidal and acyanophilic basidiospores, and the complete absence of any cystidia are its distinguishing features. The genus was recorded from dead logs (Clémençon 1982).

The type species *Chrysomphalina chrysophylla* (Fr.) Clémençon earned its epithet, "chrysophylla", from the golden hue of its lamellae (Sesli et al. 2009). It has a convex-depressed, greyish brown to brownish orange pileus with a yellowish-brown margin and scaly to fibrillose surface, and a concolourous stipe with basal white mycelium. The spacing of the lamellae is subdistant. The basidiospores are cylindrical to ellipsoidal, hyaline, and inamyloid. The basidiomata of *C. chrysophylla* are somewhat similar to those of another species, *Chrysomphalina grossula* (Pers.) Norvell, Redhead & Ammirati. However, the smaller, green-yellow convex to uplifted pileus turning almost white with maturity, and the green-yellow lamellae of *C. grossula* are completely distinguished from *C. chrysophylla* (Sesli et al. 2009).

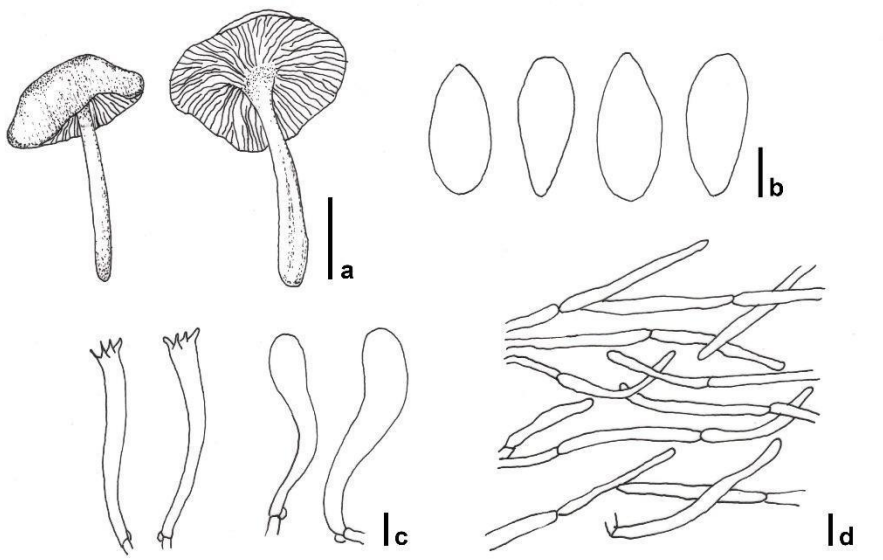


Fig. 32 – ***Chrysomphalina chrysophylla***. a Basidiomata. b Basidiospores. c Basidia & marginal cells. d Hyphal structure of lamellae. Scale bars: a = 2 cm, b = 5 µm, c & d = 10 µm. Redrawn from Sesli et al. (2009).

A revised nomenclatural study of this genus was undertaken by Norvell et al. (1994), who proposed *Chrysomphalina grossula* comb. nov. No subsequent revisionary study has since been

conducted in *Chrysomphalina*. However, in the revisionary study of morphology, pigment, and ecological studies, along with molecular phylogeny based on ITS-LSU-SSU markers of *Hygrophoraceae*, *Chrysompahlina* was incorporated (Norvell et al. 1994). The classification of *Chrysomphalina* in MycoBank, and Hyde et al. (2024a) is under *Hygrocybaceae*, whereas Species Fungorum and UNITE list it under *Hygrophoraceae* and may need updating. Currently, Species Fungorum (2026) lists five species of *Chrysomphalina*.

Synonym: *Chrysobostrychodes* G. Kost

Type species: *Chrysomphalina chrysophylla* (Fr.) Clémençon

Basionym: *Agaricus chrysophyllus* Fr.

Other species:

C. aurantiaca (Peck) Redhead

C. cantharella J.W. Liu, F.Q. Yu & K.D. Hyde

C. grossula (Pers.) Norvell, Redhead & Ammirati

C. yunnanensis Ze W. Liu, Q. Cai & Y.Y. Cui

Gliophorus Herink, Sborník Severočeského Musea, Historia Naturalis 1, 80

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 33

Classification: *Hygrocybaceae, Hygrophorineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Gliophorus was established by J. Herink, with *G. psittacinus* as its type species (Herink 1958, Lodge et al. 2014). This species was initially described based on specimens collected in Germany and classified as *Agaricus psittacinus* (Herink 1958, Lodge et al. 2014). *Gliophorus* are saprotrophic and have a global distribution (He et al. 2019). This fungus is commonly found in grasslands (Ainsworth et al. 2013). They are often referred to as waxcap fungi due to their waxy or slimy texture and frequently vibrant colours (Ainsworth et al. 2013).

Based on morphological characteristics and phylogenetic analyses, *Gliophorus* has been divided into three sections: *Gliophorus* Herink, sect. *Glutinosae* (Kühner) Lodge & Padamsee, and sect. *Unguinosae* Herink (Lodge et al. 2014). Species in sect. *Gliophorus* are characterised by conico-campanulate to convex pileus, some plano-convex with or without umbo, and colours typically green, purple, salmon or brick red (Lodge et al. 2014). Species of sect. *Unguinosae* have a grey-brown pileus, while sect. *Glutinosae* have conico-campanulate or convex pileus (Lodge et al. 2014). The taxonomic classification of *Gliophorus* is under *Hygrocybaceae* in MycoBank and Hyde et al. (2024a); however, Species Fungorum, GenBank, and UNITE place it under *Hygrophoraceae* and may need updating.

The basidiomata of *Gliophorus* display a variety of colours, including blue, violet, pink, salmon, green, ochre yellow, yellow, brick red, grey-brown, or their combination, but not bright red (Lodge et al. 2014). The pileus surface is viscid to glutinous (Lodge et al. 2014). Basidiospores are smooth, hyaline, thin-walled, inamyloid, and typically ellipsoid to ovoid, occasionally constricted, and not metachromatic (Lodge et al. 2014, Singh et al. 2017, Chakraborty et al. 2018). The basidia are primarily 4-spored, with basal clamp connections, and are about five times longer than the basidiospores (Lodge et al. 2014). Lamellae are narrowly or broadly attached, sinuate or decurrent, and sometimes gelatinised at the edges (Lodge et al. 2014, Singh et al. 2017, Chakraborty et al. 2018). Ixocheilocystidia may or may not be present, and tramal hyphae are subregular (Lodge et al. 2014, Singh et al. 2017, Chakraborty et al. 2018). The pileipellis is an ixotrichoderm with toruloid clamps. Clamp connections are present but occasionally rare in the trama. Odour is absent or has a smell resembling burned rubber (Lodge et al. 2014).

Chakraborty et al. (2018) used morphological characteristics and phylogenetic analyses (ITS) to delineate species within *Gliophorus*. Under this genus, Species Fungorum (2026) lists 20 species worldwide. Ecologically, *Gliophorus* is valued as a bio-indicator of the conservation status of grasslands or meadows (Adamčík & Kautmanová 2005, Fuljer et al. 2019).

Type species: *Gliophorus psittacinus* (Schaeff.) Herink

Basionym: *Agaricus psittacinus* (Schaeff.) Herink

Other accepted species: (Species Fungorum – search *Gliophorus*)

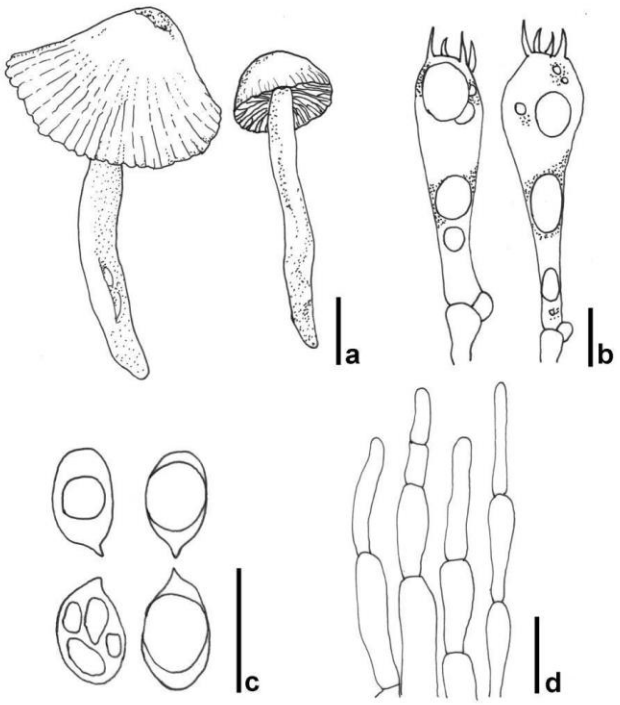


Fig. 33 – ***Gliophorus flavoviridis*** (US 1367, holotype). a Basidiomata. b Basidia. c Basidiospores. d Terminal elements of pileipellis. Scale bar: a = 10 mm, b−c = 10 µm, d = 25 µm. Redrawn from Singh et al. (2017).

Humidicutis (Singer) Singer, Sydowia 12(1–6), 225

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 34

Classification: *Hygrocybaceae, Hygrophorineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Humidicutis was established by Rolf Singer in 1958 with *H. marginata* as the type species. This genus was originally described based on specimens collected from soil in New York, USA, and classified as *Hygrophorus marginatus* Peck (Singer 1958a). Species of *Humidicutis* have a global distribution and are saprotrophic in habitat (He et al. 2019). The taxonomic classification of *Humidicutis* is under *Hygrocybaceae* under MycoBank and Hyde et al. (2024a); however, Species Fungorum, GenBank, and UNITE place it under *Hygrophoraceae* and this may need updating.

Species of *Humidicutis* are characterised by sub-hygrophanous, moist, occasionally viscid basidiomata, which are often brightly coloured or greyish brown (Lodge et al. 2014, Yuan et al. 2020). The pilei are typically convex, convex-umbonate, or conic, with margins that are rarely or not deeply splitting. Lamellae are thick, sinuate or broadly adnate, often featuring a decurrent tooth. Basidiospores are ellipsoid to broadly ellipsoid, hyaline, thin-walled, inamyloid, non-constricted, and not metachromatic. Basidia are usually five or more times longer than basidiospores. Lamellar trama are sub-regular or regular, rarely tapered, and possess right-angled septa. The cuticular hyphae usually contain carotenoid pigments and may also exhibit encrusting pigments that are insoluble in alkaline solutions. Pileipellis hyphae are parallel, prostrate, and cylindrical. Clamp connections are absent in context and pellis but are present as toruloid clamps at the base of basidia and/or basidioles. These fungi have either no odour or a mildly disagreeable one (Lodge et al. 2014, Yuan et al. 2020).

Humidicutis is distinct from *Hygrocybe* (Fr.) P. Kumm., due to clamp connections only at the base of basidia and differences in pigment composition (absence of muscaflavin in basidiomata)

(Desjardin & Hemmes 1997). Under *Humidicutis*, Species Fungorum (2026) lists 22 species worldwide.

Reschke et al. (2021) described a new species, *H. roseorubra* Reschke & C.W. Fisch., based on morphological and phylogenetic analyses. This species is distinct from other species of *Humidicutis* by the combination of conical, rose-red basidiomata, basidia with long sterigmata, and ellipsoidal to ovoid basidiospores (Reschke et al. 2021). Cardoso et al. (2023) described another new species, *H. pindorama* J.S. Cardoso, M.A. Neves & J.S. Oliveira, based on morphological characteristics and phylogenetic analyses (ITS).

Synonymy: *Tricholoma* subgen. *Humidicutis* Singer

Type species: *Humidicutis marginata* (Peck) Singer

Basionym: *Hygrophorus marginatus* Peck

Other accepted species: (Species Fungorum – search *Humidicutis*)

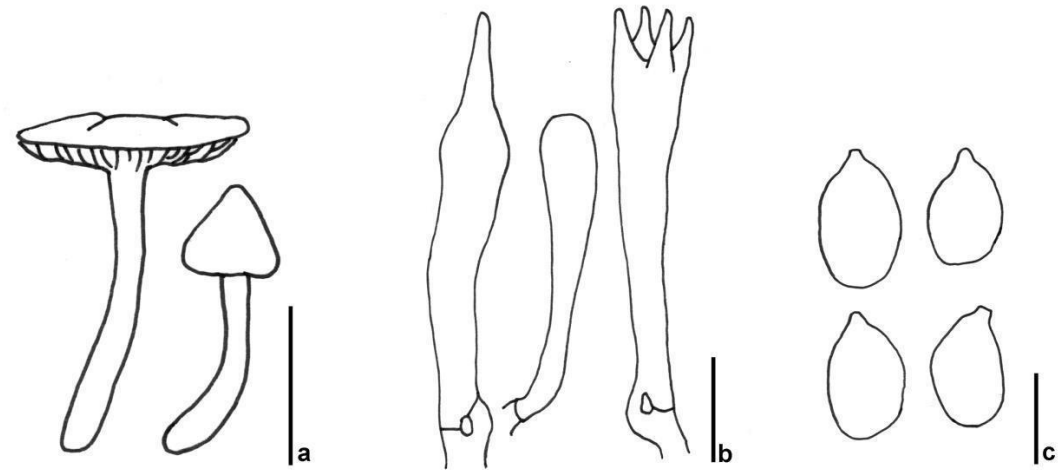


Fig. 34 – ***Humidicutis peleae*** (a = DED 5506, b–c = DEH 492). a Basidiomata. b Basidia and basidioles. c Basidiospores. Scale bar: a = 10 mm, b = 5 µm, c = 10 µm. Redrawn from Desjardin & Hemmes (1997).

Hygroaster Singer, Sydowia 9(1–6), 370

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 35

Classification: *Hygrophoraceae, Hygrophorineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Hygroaster was established by R. Singer in 1955, with *H. nodulisporus* as its type species (Singer 1955). This species was originally described from soil samples collected in Trinidad and Tobago (Singer 1955). Subsequently, Lodge et al. (2014) revised the genus, excluding temperate species with bright pigments and sub-angular basidiospores. In addition, the initial combination of *Hygrophorus nodulisporus* under *Hygroaster* was invalid and later formally validated (Ralaiveloarisoa et al. 2020). Members of this genus are saprobic and are found in tropical forests across Argentina, Brazil, China, Colombia, India, Madagascar, and Sweden (Niveiro & Alberto 2012, He et al. 2019, Ralaiveloarisoa et al. 2020). The classification of *Hygroaster* is under *Hygrophoraceae* in Species Fungorum and GenBank; however, MycoBank and Hyde et al. (2024a) have synonymised the genus with *Hygrocybe* (Fr.) P. Kumm., under *Hygrocybaceae* (Padamsee & Lodge) Vizzini, Consiglio & P. Alvarado.

Hygroaster is characterised by basidiomata with an indented, non-viscid pileus that is fuscous or white, lacking bright pigments (Lodge et al. 2014, Ralaiveloarisoa et al. 2020). The lamellae are thick, decurrent, and either distant or sub-distant. Lamellar trama is subregular, with pigmentation present in the central strand of the pigmented species (Lodge et al. 2014, Ralaiveloarisoa et al. 2020). Basidiospores are subglobose to globose, with long, conical spines that have blunt or acute

apices, hyaline, inamyloid, and not cyanophilous (Lodge et al. 2014, Ralaiveloarisoa et al. 2020). Basidia are clavate, hyaline, and bear 2–4 sterigmata (Ralaiveloarisoa et al. 2020). Pileipellis hyphae are lightly encrusted and lack cystidia; clamp connections are absent (Lodge et al. 2014, Ralaiveloarisoa et al. 2020).

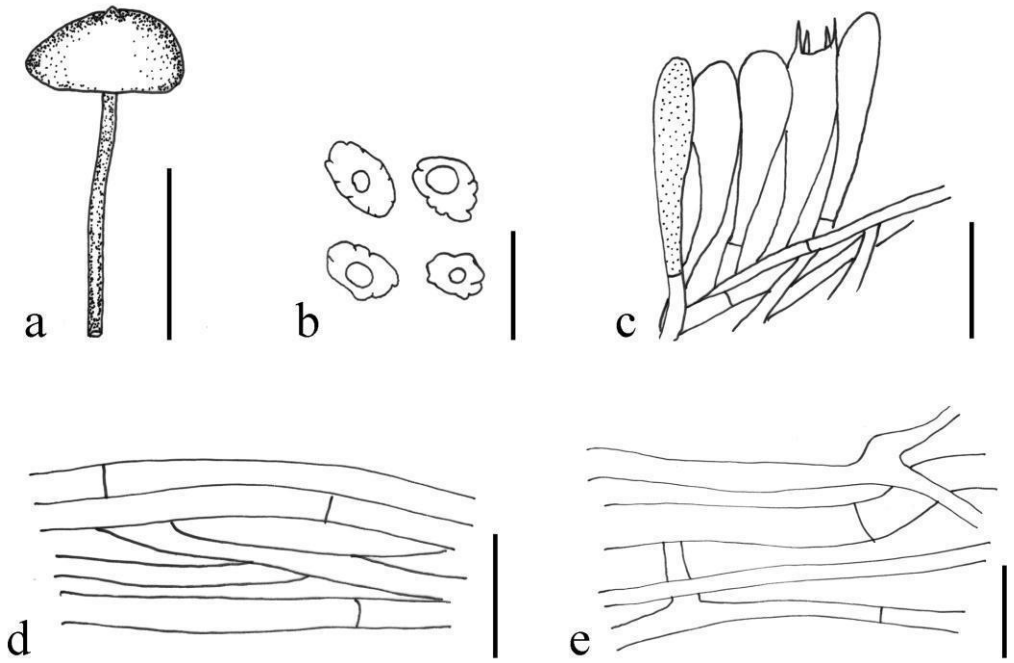


Fig. 35 – ***Hygroaster iguazuensis***. a Basidiomata. b Basidiospores. c Basidia, basidioles, pseudocystidia. d Pileipellis. e Hyphae from the context. Scale bar: a = 1.5 cm, b = 20 µm, c–e = 10 µm. Redrawn from Lechner et al. (2005). For original basidiomata, refer to Lechner et al. (2005).

Ralaiveloarisoa et al. (2020) described two new species, *H. madagascarensis* and *H. andasibensis*, from Madagascar using morphological characteristics and phylogenetic analyses (ITS). Species Fungorum (2026) lists only 10 species worldwide. *Hygroaster* is closely related to *Hygrocybe* (Fr.) P. Kumm. However, the latter is distinct by having smooth basidiospores and the presence of clamp connections (Ralaiveloarisoa et al. 2020).

Type species: *Hygroaster nodulisporus* (Dennis) Singer

Basionym: *Hygrophorus nodulisporus* Dennis

Other accepted species:

H. agrumbensis Sathe & S.M. Kulk.
H. albellus Singer
H. andasibensis Ralaiv., Niskanen & Liimat.
H. cleefii Franco-Mol. & López-Quint.
H. iguazuensis B.E. Lechner & J.E. Wright
H. lacteus E. Ludw. & Ryberg
H. madagascarensis Ralaiv., Niskanen & Liimat.
H. sulcatus (Z.S. Bi) T.H. Li & Z.S. Bi
H. trachysporus Z.S. Bi

Hygrophoraceae Lotsy, Vorträge über botanische Stammesgeschichte 1, 705

Species Fungorum, Facesoffungi, MycoBank, GenBank

Classification: *Hygrophorineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Hygrophoraceae was established by J.P. Lotsy in 1907 with the type genus *Hygrophorus* Fr. (Lotsy 1907). Lodge et al. (2014) reported 25 genera comprising more than 600 species. However, Hyde et al (2024a) recognised six genera: *Aeruginospora* Höhn., *Haasiella* Kotl. & Pouzar, *Hygrocybula* De la Peña-Lastra, A. Mateos & Plaza, *Hygrophorus*, *Melanomphalia* M.P. Christ., and *Semiomphalina* Redhead. *Hygrophoraceae* is characterised by gymnocarpous or secondarily mixangiocarpous basidiomata, with subdecurrent to deeply decurrent lamellae, divergent or bidirectional hymenophoral trama, and a pachypodial structure below the active hymenium (Vizzini et al. 2024). Basidiospores are thin- or thick-walled, inamyloid, metachromatic or not, hyaline or lightly pigmented (Vizzini et al. 2024). *Hygrophorus* forms either saprotrophic or ectomycorrhizal associations with trees (Tedersoo et al. 2010, Seitzman et al. 2011). Some genera form lichens with green algae or cyanobacteria, while others associate with ferns, grasses, and bryophytes (Lawrey et al. 2009, Lodge et al. 2014). Species of *Hygrophoraceae* are distributed worldwide (He et al. 2019).

Haasiella Kotl. & Pouzar, Česká Mykologie 20(3), 135

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 36

Classification: *Hygrophoraceae, Hygrophorineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Haasiella was established by Kotlaba & Pouzar to accommodate two rare omphalinoid agarics, *H. venustissima* (type species) and *H. splendidissima*. Small, pink-orange basidiomata characterise these fungi due to carotenoid pigments (Arpin 1966), a lignicolous habitat, a yellow-pinkish spore print, a gelatinised pileipellis, elongated basidia, a bidirectional lamella trama, and metachromatic spores in cresyl blue (Kotlaba & Pouzar 1966, Vizzini et al. 2012a). The two taxa were historically distinguished by basidial morphology and the presence of clamp connections; *H. venustissima* has mono- or bisporic basidia and lacks clamps, while *H. splendidissima* has tetrasporic basidia and clamp connections.

Molecular phylogenetic analyses based on combined ITS and LSU sequences (Vizzini et al. 2012a) revealed that *Haasiella* belongs to the Hygrophoroid clade within *Hygrophoraceae*, where it is sister to *Hygrophorus*. The study demonstrated that *H. venustissima* and *H. splendidissima* are conspecific; the latter represents the tetrasporic, clamped, and heterothallic form of the former. This suggests that *H. splendidissima* is not a distinct species but rather a life-cycle variant of *H. venustissima*.

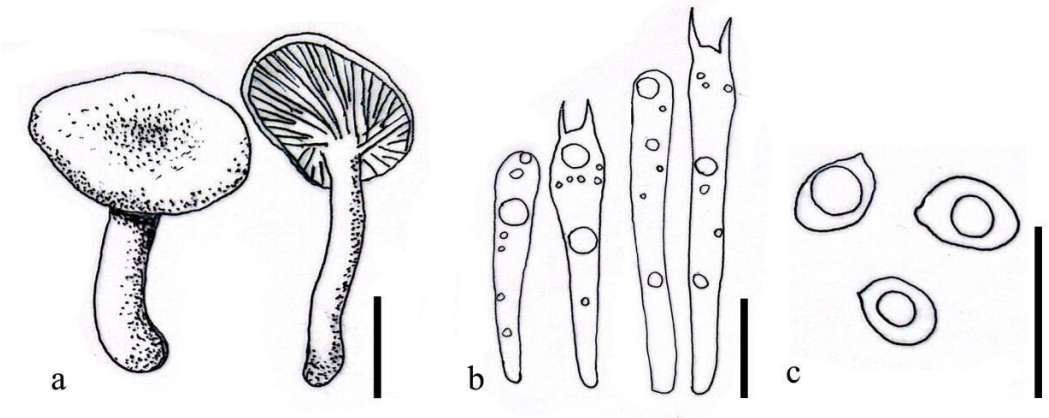


Fig. 36 – ***Haasiella venustissima***. a Basidiomata. b Basidia and basidioles. c Basidiospores. Scale bars: a = 1 cm, b–c = 10 µm. Redrawn from Chvikov & Prylutskyi (2020). For original basidiomata, refer to Chvikov & Prylutskyi (2020).

Haasiella species are saprotrophic on wood and woody debris and have been reported only from Europe. They are considered rare and are included in red lists of threatened fungi in several European countries (Senn-Iriet et al. 2007). The genus is morphologically and chemically similar to *Chrysomphalina* but differs in spore metachromasy and pileipellis structure (Kost 1986). The

classification of *Haasiella* in *Hygrophoraceae, Hygrophorineae*, *Agaricales, Agaricomycetidae, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* is in agreement in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Type species: *Haasiella venustissima* (Fr.) Kotl. & Pouzar ex Chiaffi & Surault

Basionym: *Agaricus venustissimus* Fr.

Other accepted species:

H. sinensis Y.Dan Zhang & Xue T. Zhu

Hygrophorus Fr., Flora Scanica, 339

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 37

Classification: *Hygrophoraceae, Hygrophorineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Hygrophorus was originally described by Fries (1836) as the type genus of *Hygrophoraceae* Lotsy. (Fries 1836, Lodge et al. 2014). The type species, *H. eburneus*, was initially described as *Agaricus eburneus* Bull. (Bulliard 1783). Singer (1986) provided the authentic generic concept of *Hygrophorus* within *Hygrophoraceae*, as divergent tramenophoral trama, ectomycorrhizal habit, and commonly clamped hyphae. Members of *Hygrophorus* are ectomycorrhizal with a worldwide distribution, mainly in temperate regions of the Northern Hemisphere (Endo et al. 2018, He et al. 2019).

The genus has undergone several taxonomic revisions. Fries (1836) divided it into three subgenera: subg. *Hygrophorus* Fr., subg. *Colorate* (Bataille) E. Larss., and subg. *Camarophylli* Fr. Hesler and Smith (1963) further subdivided the genus into eight subsections based on morphology. Later, taxonomic arrangements have been changed by several authors (Bresinsky & Huber 1967, Arnolds 1986, Singer 1986, Horak 1990, Kovalenko 2012). Based on molecular analyses, *Hygrophorus* has a monophyletic lineage (Lodge et al. 2014, Endo et al. 2018). Under *Hygrophorus*, Hyde et al. (2024a) have listed approximately 260 species worldwide. Wang et al. (2023) described 26 new species, based on a combination of morphological characteristics and phylogenetic analyses (ITS, LSU, *rpb2*, and *tef1-α*). The classification of *Hygrophorus* in *Hygrophoraceae, Hygrophorineae*, *Agaricales, Agaricomycetidae, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* is in agreement in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Members of *Hygrophorus* are characterised by tricholomatoid, collybioid, clitocyboid, or omphalinoid basidiomata, ranging from small to large, thin to fleshy, and dry to very glutinous or viscid (Singer 1986, Kovalenko 2012, Sesli et al. 2018). The pileus varies in colour from whitish, grey, brownish, yellowish, orange, or reddish, and is dry to moderately sticky. The lamellae are adnate to decurrent, thick, waxy, and usually whitish, sometimes yellowish or pinkish. The stipe is dry to glutinous, glabrous to fibrillose, and often pruinose or granulose. The basidia are narrowly clavate, while basidiospores are hyaline, smooth, and inamyloid (Singer 1986, Kovalenko 2012, Sesli et al. 2018).

Members of *Hygrophorus* have ecological and economic significance. Several species, such as *H. annulatus* C.Q. Wang & T.H. Li, *H. eburneus* (Bull.) Fr., and *H. yukishiro* N. Endo, Tokoo & A. Yamada are edible (Yamada 2002). *Hygrophorus eburneus* has also been reported to exhibit medicinal properties, including neuroprotective, antimicrobial, antioxidative, and anticancer activities (Kosanic et al. 2020). Additionally, bioactive compounds have been isolated from species of this genus. For example, acylcyclopentenedione derivatives with antifungal activity were obtained from *H. chrysodon* (Batsch) Fr. (Gilardoni et al. 2007).

Synonymy: *Agaricus* + *Camarophyllus* Fr. ex Rabenh., *Agaricus* +++ *Limacium* Fr. ex Rabenh., *Agaricus* subtrib. *Camarophylli* Fr., *Agaricus* trib. *Limacium* Fr., *Camarophyllus* (Fr.) P. Kumm., *Hygrophorus* subgen. *Camarophyllus* Fr., *Hygrophorus* subgen. *Limacinus* Quél., *Limacinus* (Quél.) Marchand, *Limacium* (Fr. ex Rabenh.) P. Kumm.

Type species: *Hygrophorus eburneus* (Bull.) Fr.

Basionym: *Agaricus eburneus* Bill.
Other accepted species: (Species Fungorum – search *Hygrophorus*)

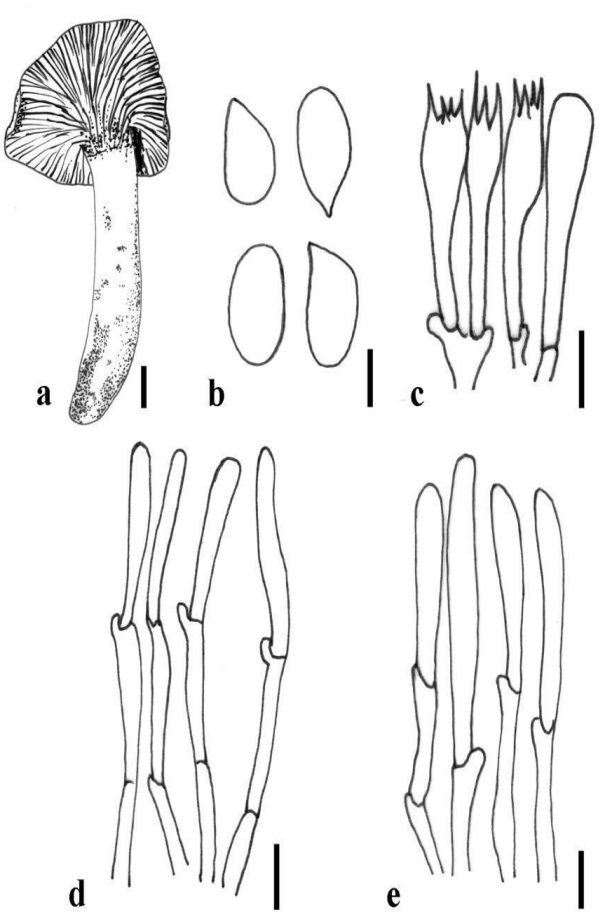


Fig. 37 – ***Hygrophorus alboflavescens*** (LAH35243, holotype). a Basidiomata. b Basidiospores. c Basidia and basidioles. d Pileipellis. e Stipitipellis. Scale bar: a = 1.5 cm, b = 4.5 µm, c = 2 µm. d = 13.7 µm. e = 7.8 µm. Redrawn from Naseer et al. (2019). For original basidiomata, refer to Naseer et al. (2019).

Marasmiineae Aime, Dentinger & Gaya
Species Fungorum, Facesoffungi, MycoBank, GenBank

Campanellaceae J.S. Oliveira, Desjardin & Moncalvo, Fungal Diversity 127, 38
Species Fungorum, Facesoffungi, MycoBank, GenBank
Classification: *Marasmiineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

The family *Campanellaceae* is a recently delimited and phylogenetically well-supported lineage of agaricoid and corticioid fungi within the *Agaricales* (Oliveira et al. 2024). This family represents a limited subset of the tribe *Collybieae* as circumscribed within the *Tricholomataceae* sensu (Singer 1986). The recognition of this family clarifies a protracted taxonomic impasse that had dispersed pleurotoid, tetrapyrgoid, and resupinate taxa that were historically dispersed among *Tricholomataceae*, *Marasmiaceae*, and allied families based primarily on superficial morphological similarities (Oliveira et al. 2024). Phylogenetic studies have resulted in a major taxonomic rearrangement supported by a strongly resolved monophyletic clade corresponding to *Campanellaceae* (Desjardin et al. 2017). Currently, the family includes five genera: *Brunneocorticium* Sheng H. Wu, *Campanella* Henn., *Metacampanella* R.H. Petersen, *Neocampanella* Nakasone, Hibbett & Goranova, and *Tetrapyrgos* E. Horak (Hyde et al. 2024a).

Although molecular data corroborate the monophyly of each within *Campanellaceae*, intergeneric relationships and precise generic boundaries remain partially ambiguous, an artifact of incomplete taxon sampling and restricted geographic representation (Oliveira et al. 2024).

Brunneocorticium Sheng H. Wu, in Wu, Wang & Tschen, Mycologia 99(2), 303
Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 38
Classification: *Campanellaceae*, *Marasmiineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Brunneocorticium was introduced by Wu et al. (2007) and is supported by both morphological characteristics and molecular phylogeny within the euagarics clade. The basidiomata of *Brunneocorticium* are crust-like and resupinate, with a smooth hymenial surface (Wu et al. 2007). The margins are brown and cracked, further distinguishing this genus. The hyphal system is dimitic, consisting of nodose-septate generative hyphae and abundant yellow-brown skeletal hyphae, which are occasionally branched and thick-walled. These skeletal hyphae give the subiculum a characteristic brown colour. The species also features leptocystidia, specialised cystidia commonly associated with corticioid fungi. The basidia are subclavate, with a median constriction, and bear two-sterigmata. The basidiospores are hyaline, pyriform, with a small apiculus, smooth, thin-walled, and often guttulate. They are negative in iodine (IKI-) and cotton blue (CB-) staining tests (Wu et al. 2007). *Brunneocorticium* was collected in subtropical and tropical regions of Belize, Brazil, China, Ecuador, Guyana, Peru, and Suriname. It is found growing on the bark of living *Murraya* species (*Rutaceae*), an angiosperm host, and is a web-blight of young shoots (Wu et al. 2007, Koch et al. 2018).

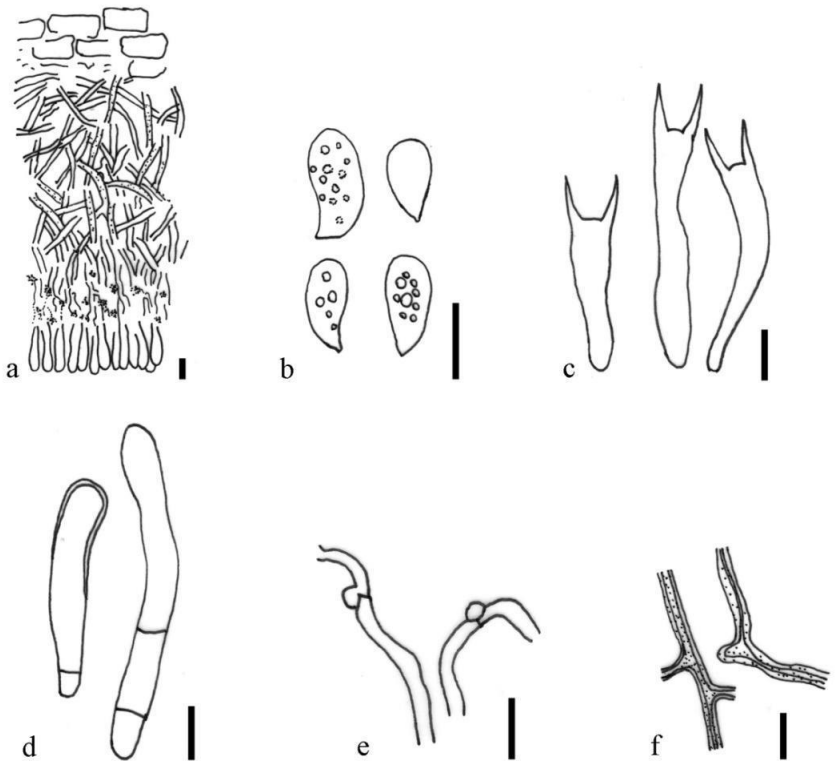


Fig. 38 – ***Brunneocorticium pyriforme*** (Chen774, holotype). a Cross-sectional view of basidiomata. b Basidiospores. c Basidia. d Leptocystidia. e Generative hyphae. f Skeletal hyphae. Scale bars: a–f = 10 μm. Redrawn from Wu et al. (2007). For original basidiomata, refer to Wu et al. (2007).

Brunneocorticium demonstrates intriguing phylogenetic relationships and morphological diversity. One notable species, *B. corynecarpon*, originally classified as *Rhizomorpha*

corynecarpos, forms sterile rhizomorphs that lacked basidia (Koch et al. 2018). Molecular phylogenetic analysis has revealed its close alignment with *Brunneocorticium*. Another species, *B. bisporum*, initially identified as a crust fungus growing on living trunks and fallen branches, produces basidia within a hymenium. However, it was later reassigned to a newly established genus *Dendrodontia*, becoming *D. bispora* (Koch et al. 2018). In terms of evolutionary relationships, *Brunneocorticium* is phylogenetically aligned with agaricoid genera, such as *Marasmiellus* and *Campanella* (Wu et al. 2007). More recently, the newly described genus *Neocampanella* has been found to share sequence similarities within this complex (Bernard & Bart 2012). According to Koch et al. (2018), additional species demonstrate close phylogenetic relations within this group. Currently, *Brunneocorticium* ITS, LSU, and SSU are available in the NCBI database. The classification of *Brunneocorticium* as *Marasmiaceae, Agaricales, Agaricomycetidae, Agaricomycetes, Agaricomycotina, Basidiomycota* is in agreement with Species Fungorum, UNITE, He et al. (2019, 2024), and Wijayawardene et al. (2022). However, in the recent delimitation of *Campanellaceae* based on morphology and phylogeny, the genus has been synonymised under this genus (Oliveira et al. 2024, Hyde et al. 2024a).

Type species: *Brunneocorticium pyriforme* Sheng H. Wu

Other accepted species:

B. corynecarpon (Kunze) R.A. Koch, Lodge, Nakasone & Aime

Tetrapyrgos E. Horak, Sydowia 39, 101

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 39

Classification: *Campanellaceae*, *Marasmiineae*, *Agaricales*, *Agaricomycetes*, *Agaricomycotina*, *Basidiomycota*, *Fungi*

Tetrapyrgos represents a genus of marasmioid–gymnopoid agarics that is typified by *T. atrocyanea* (Métrod) E. Horak. The genus initially originated as the monotypic *Pterospora* Métrod, based on *P. atrocyanea* Métrod as the type species (Métrod 1949). Because the name *Pterospora* had already been validly published for a genus in *Pyrolaceae*, Horak (1987) introduced the replacement name *Tetrapyrgos*. Initially, Horak (1983, 1987) recognised 15 species in the genus, including taxa formerly classified under *Campanella* Henn., *Marasmiellus* Murrill, and *Marasmius* Fries. An additional species was described by Petersen & Gordon (1994), bringing the total number to 16 species (Komura et al. 2020). Of these 16 species, Honan et al. (2015) recognised only nine as belonging to *Tetrapyrgos s. s.*, while the remaining seven were classified as being closer to *Campanella*. Within *Tetrapyrgos*, Species Fungorum (2026) lists 22 species.

Members of *Tetrapyrgos* are characterised by small marasmioid basidiomata, a white pileus, and a darker, pruinose central stipe. The pileipellis and pileus trama tissues are not noticeably gelatinous. The pileipellis elements are rameales-like or coralliform, and the basidiospores are tetrahedral (Horak 1987, Honan et al. 2015, Deng et al. 2024). The species within this genus are saprotrophic, commonly found in tropical forests, and typically grow on leaves and woody debris in the litter layer (Horak 1987).

Tetrapyrgos atrocyanea, originally described from Madagascar, was recollected at the type locality, and a specimen was designated as the epitype (Desjardin et al. 2017), along with an ITS region. Honan (2007) and Honan et al. (2015) revised the genus circumscription using both morphological traits and ITS sequences. Komura et al. (2020) described six new species of *Tetrapyrgos* from the Brazilian Amazon based on morphological and ITS data. Recently, Deng et al. (2024) described a new species, *T. tomentella* from China using morphological characteristics along with phylogenetic analysis based on ITS sequences. *Tetrapyrgos tomentella* is characterised by a pure white pileus, a tomentose black stipe, tetrahedral spores, and diverticulate cheilocystidia and pileipellis elements. It resembles *T. nigripes* but can be differentiated by crowded lamellae and variability of the abundance of caulocystidia (Deng et al. 2024). The classification of *Tetrapyrgos* in MycoBank, GenBank, and Hyde et al. (2024a) is under *Campanellaceae*, whereas Species Fungorum and UNITE list it under *Marasmiaceae* and may need updating.

Synonym: *Pterospora* Métrod

Type species: *Tetrapyrgos atrocyanea* (Métrod) E. Horak
Basionym: *Pterospora atrocyanea* Métrod
Other accepted species: (Species Fungorum – search *Tetrapyrgos*)

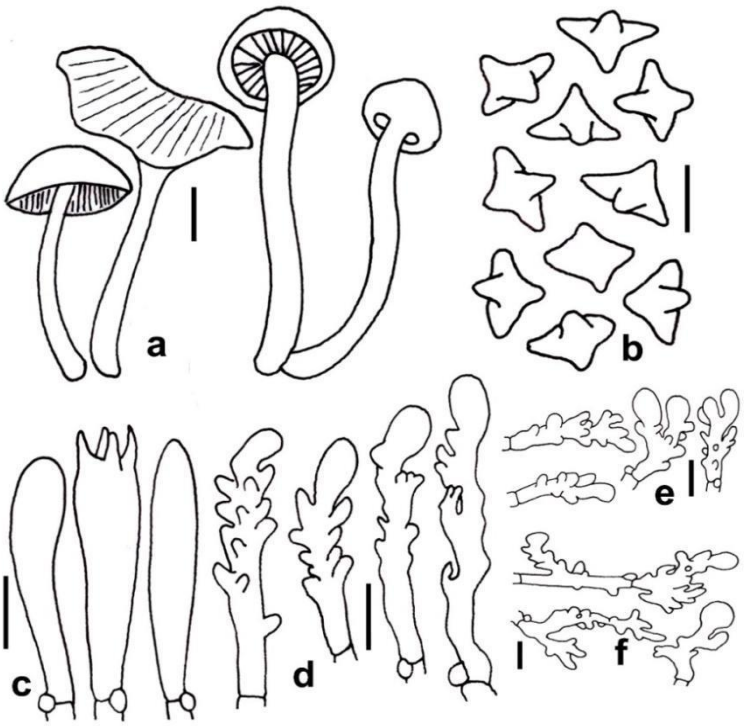


Fig. 39 – ***Tetrapyrgos atrocyanea***. a Basidiomata. b Basidiospores. c Basidium and basidioles. d Cheilocystidia. e Pileipellis terminal cells. f Stipitipellis cells. Scale bar: a = 10 mm, b–f = 10 µm. Redrawn from Desjardin et al. (2017). For original basidiomata, refer to Desjardin et al. (2017).

Cyphellaceae Burnett, Outlines of Botany (London), 233
Species Fungorum, Facesoffungi, MycoBank, GenBank
Classification: *Marasmiineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Cyphellaceae is a small monophyletic family established by G.T. Burnett in 1935 with the type genus *Cyphella* Fr. (Burnett 1835). This family is characterised by agaricoid, cyphelloid, clavarioid, pleurotoid, corticioid, or stereoid basidiomata types (Vizzini et al. 2022, Zhang et al. 2024). *Cyphellaceae* accommodates 24 genera: *Asterocyphella* W.B. Cooke, *Atheniella* Redhead, Moncalvo, Vilgalys, Desjardin & B.A. Perry, *Baeospora* Singer, *Campanophyllum* Cifuentes & R.H. Petersen, *Catilla* Pat., *Cheimonophyllum* Singer, *Chondrostereum* Pouzar, *Cunninghammyces* Stalpers, *Cyphella* Fr., *Gloeocorticium* Hjortstam & Ryvarden, *Gloeostereum* S. Ito & S. Imai, *Granulobasidium* Jülich, *Henningsomyces* Kuntze, *Incrustocalyptella* Agerer, *Lignomphalia* Antonín, Borovička, Holec & Kolařík, *Mycenella* (J.E. Lange) Singer, *Mycopan* Redhead, Moncalvo & Vilgalys, *Phaeoporotheleum* (W.B. Cooke) W.B. Cooke, *Phloeomana* Redhead, *Pleurella* E. Horak, *Seticyphella* Agerer, *Setigeroclavula* R.H. Petersen, *Sphaerobasidioscypha* Agerer, and *Thujacorticium* Ginns (Hyde et al. 2024a). Recently, Zhang et al. (2024) described an additional new genus, *Stratocorticium* S.H. He, Y.P. Zhang & Nakasone, based on morphology and phylogenetic analyses (ITS and LSU). Members of *Cyphellaceae* are saprophytic and are distributed worldwide (Zhang et al. 2024).

Asterocyphella W.B. Cooke, Beihefte zur Sydowia 4, 118
Species Fungorum, Facesoffungi, MycoBank

Classification: *Cyphellaceae, Marasmiineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Asterocyphella was established by W.B. Cooke in 1961 to accommodate one new species, *A. floccose*, and two species transferred to the genus, *A. friesii* and *A. theiacantha*. The type specimen of *A. floccose* was collected from dead branches of *Serjana fulta* in Tucuman, Argentina (Cooke 1961). Species of *Asterocyphella* are distributed worldwide (Cooke 1961, He et al. 2019).

Asterocyphella species are characterised by their receptacles, which can be either sessile or subsessile and are covered by a floccose network of surface hairs (Cooke 1961). These hairs may branch and anastomose or be simple and elongated. The receptacles consist of three tissue layers: a loose to compact layer of hyphae that produces the surface hairs, a compact layer of context tissue, and the hymenium, which is made up of basidia. The basidiospores are brown and globose to ovate or asperulate (Cooke 1961).

Identification of *Asterocyphella* species relies exclusively on macro- and micro-morphological features, as no molecular data have been reported (Cooke 1961, He et al. 2019). The classification of *Asterocyphella* in *Cyphellaceae, Marasmiineae*, *Agaricales, Agaricomycetidae, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* is in agreement in Species Fungorum, MycoBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Type species: *Asterocyphella floccosa* W.B. Cooke

Other accepted species:

A. friesii (Quél.) W.B. Cooke

A. theiacantha (Syd. & P. Syd.) W.B. Cooke

Baeospora Singer, Revue de Mycologie 3(4–5), 193

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 40

Classification: *Cyphellaceae, Marasmiineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Baeospora was established by Rolf Singer and initially placed within *Tricholomataceae* R. Heim ex Pouzar, but recent molecular phylogenetic studies have assigned it to subfamily *Pseudobaeosporoideae* Vizzini, Consiglio & Setti under *Tricholomataceae sensu lato* (Singer 1938, 1986, Sánchez-García et al. 2014, Vizzini 2025). The type species, *B. myosura* (Fr.) Singer was originally described as *Agaricus myosurus* Fr. and later transferred by Singer when erecting the genus (Singer 1938, 1986). These fungi are predominantly found among mosses, on conifer cones, or on decaying wood. The species of the genus are distributed across Europe, Asia, and North America (Singer 1938). Within *Baeospora*, Species Fungorum (2026) lists 12 species worldwide.

Pileus convex to plano, occasionally papillate, but never conical or campanulate; margin initially curved. Stipe slender, tubular, and cartilaginous, sometimes slightly tenacious; hyphae with or without clamp connections (Singer 1938, Hutchison et al 2012). Lamellae are narrow, subfree, and whitish to lilac-violet in colour (Singer 1938). The hymenophoral trama is subregular, often consisting partly of shorter elements, and may be amyloid or inamyloid. Cystidia are sometimes inconspicuous but more commonly present along the edge or sides of the lamellae, though not voluminous. The pileipellis is composed of hyphae that are non-erect or only slightly erect, variable in form, mostly smooth, elongate, and non-hymeniform. Basidiospores are minute, ellipsoid to subglobose, hyaline, amyloid or pseudoamyloid, smooth, and form a white spore print (Singer 1938). Thirteen species of *Baeospora* are known, of which ten are tropical with *B. myosura* (Fr.) Singer and *B. myriadophylla* (Peck) Singer are temperate representatives (Hutchison et al 2012, Wijayawardene et al 2022).

Recent molecular phylogenetic studies have revealed that the traditional *Tricholomataceae* is polyphyletic, and *Baeospora* represents an independent lineage within *Agaricales*. Consequently, it has been assigned to the subfamily *Pseudobaeosporoideae* under *Tricholomataceae* sensu lato (Sánchez-García et al. 2014, Vizzini 2025). *Pseudobaeospora* Singer is considered a morphologically as well as phylogenetically linked genus to *Baeospora*; however, Singer separated it due to the presence of amyloid tissues and subtle differences in spore morphology; molecular

data also indicate both genera belong to *Pseudobaeosporoideae* subfamily within *Tricholomataceae sensu lato* (Singer 1938, Vizzini 2025). The classification of *Baeospora* in MycoBank and Hyde et al. (2024a) is under *Cyphellaceae*, whereas Species Fungorum, GenBank, and UNITE list it under *incertae sedis* and may need updating.

Type species: *Baeospora myosura* (Fr.) Singer

Basionym: *Agaricus myosurus* Fr.

Other accepted species: (Species Fungorum – search *Baeospora*)

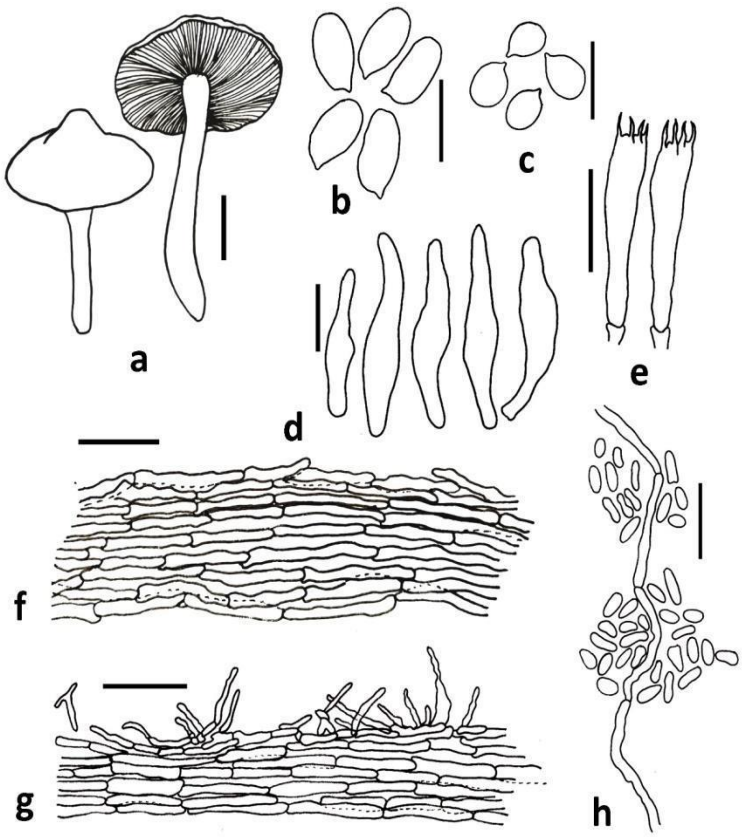


Fig. 40 – ***Baeospora occidentalis*** (DAOM 234428, holotype). a Basidiomata. b Basidiospores. c Four immature basidiospores. d Cheilocystidia. e Basidium. f Cross-section of pileipellis showing repent hyphae. g Caulocystidia. h Arthroconidia. Scale bars: a = 10 mm. b–h = 10 µm. Redrawn from Hutchison et al (2012). For original basidiomata, refer to Hutchison et al (2012).

Catilla Pat., Bulletin de la Société Mycologique de France 31(1), 32

Species Fungorum, Facesoffungi, MycoBank Fig. 41

Classification: *Cyphellaceae, Marasmiineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Catilla is a monotypic genus established by N. Patouillard in 1915 to accommodate its type species, *C. pandani* (Patouillard 1915, Hyde et al. 2024a). The generic name *Catilla* is derived from "Catillus", which means small bowl (Patouillard 1915). The type species was initially described as *Cyphella pandani* Pat., based on specimens collected from branches of *Pandanus* in Tuamotu, French Polynesia (Patouillard 1906).

Catilla is characterised by small, cyphelliform, bowl-shaped basidiomata entirely covered with a gelatinous layer (Patouillard 1915). A regular hymenium covers the inner concave surface part, while the margin is covered by a layer of basidiform cells that are rounded at the apical ends, attenuated into a stipitiform portion, and are mixed with hyaline and cystidioform hairs.

Basidiospores are hyaline, narrow, and cylindrical, whereas basidia are hyaline, round to ovoid, with 2- or 4-spored subulate sterigmata. Hyphae are slender and sub-gelatinous (Patouillard 1915).

Identification of *Catilla* solely depends on morphological characteristics due to the lack of molecular data (He et al. 2019), highlighting the need for molecular phylogenetic analyses to clarify the taxonomic placement of this genus. The classification of *Catilla* in *Cyphellaceae, Marasmiineae*, *Agaricales, Agaricomycetidae, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* is in agreement in Species Fungorum, MycoBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Type species: *Catilla pandani* (Pat.) Pat.

Basionym: *Cyphella pandani* Pat.

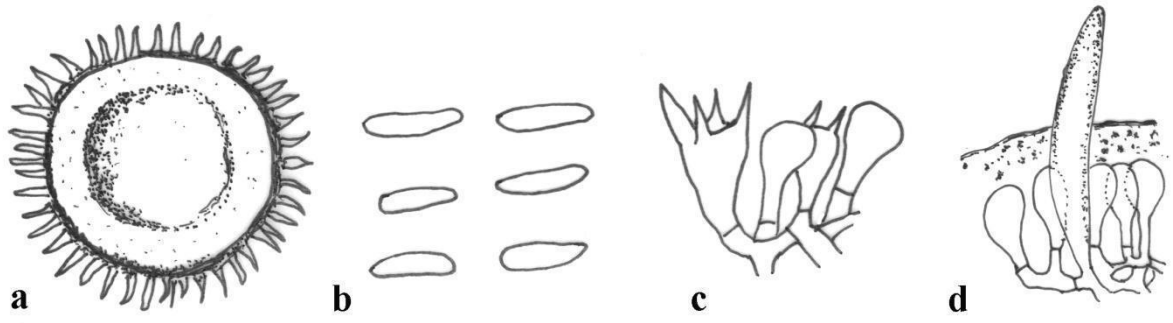


Fig. 41 – ***Catilla pandani***. a Basidiomata. b Basidiospores. c Basidia and basidioles. d Cystidiform hair and external cells immersed in gelatin. Scale bar: Not available in the original description. Redrawn from Patouillard (1915).

Cunninghammyces Stalpers, New Zealand Journal of Botany 23(2), 309

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 42

Classification: *Cyphellaceae, Marasmiineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Cunninghammyces was established by J.A. Stalpers in 1985 to accommodate its type species, *C. umbonatus.* This species was originally classified under the genus *Corticium* Pers. (Stalpers 1985). The type specimen of *C. umbonatus* was first collected from the bark of dead stems in New Zealand (Cunningham 1954). Subsequently, Boidin et al. (1993) described another species, *C. fusisporus*, based on a specimen from Réunion. In addition, species of *Cunninghammyces* have been reported from Venezuela, China, and Costa Rica (Hjortstam & Ryvarden 1983, Boidin et al. 1993).

Species of *Cunninghammyces* are characterised by their annual, resupinate, effused basidiomata, which possess a pellicular to membranaceous texture (Stalpers 1985). The hymenium is easily separable from the subiculum and the substrate. The basidiospores are hyaline, thin to slightly thick-walled, inamyloid, echinulate with a smooth suprahilar plage, and often contain large globules. Basidia are hyaline, thin-walled, and clavate to typically urniform. They can be terminal or lateral, each bearing four sterigmata. The hyphae are hyaline, thin to somewhat thick-walled, and feature clamp connections (Stalpers 1985).

Identification of *Cunninghammyces* species primarily relies on morphological characteristics due to a lack of molecular data (He et al. 2019). However, a few sequences have been uploaded to GenBank (2024), which are not supported by any valid publications. The classification of *Cunninghammyces* in *Cyphellaceae, Marasmiineae*, *Agaricales, Agaricomycetidae, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* is in agreement in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Type species: *C. umbonatus* (G. Cunn.) Stalpers

Basionym: *Corticium umbonatum* G. Cunn.

Other accepted species: *C. fusisporus* Boidin & Gilles

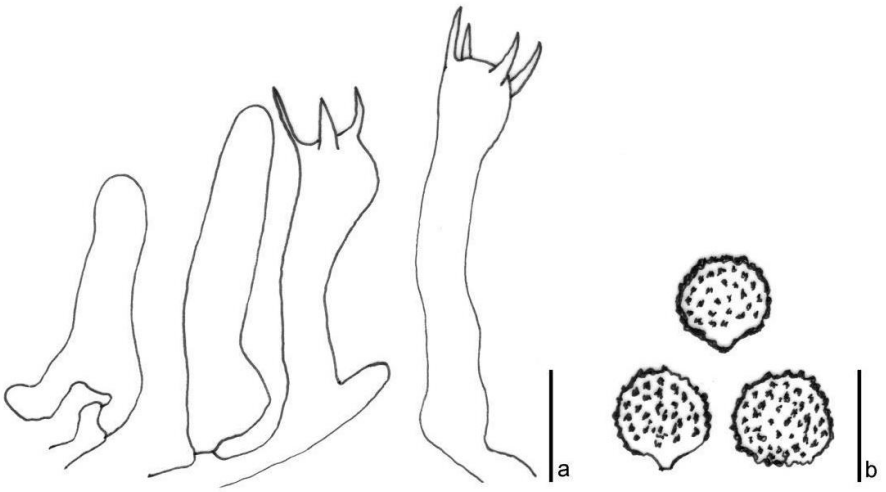


Fig. 42 – ***Cunninghammyces umbonatus***. a Stages of basidium development. b Basidiospores. Scale bar: a−b = 10 µm. Redrawn from Stalpers (1985).

Gloeocorticium Hjortstam & Ryvarden, Mycotaxon 25(2), 551

Species Fungorum, Facesoffungi, MycoBank Fig. 43

Classification: *Cyphellaceae, Marasmiineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Gloeocorticium, a monotypic genus, was established by K. Hjortstam and L. Ryvarden in 1986 (Hjortstam & Ryvarden 1986, Hyde et al. 2024a). The type species, *G. cinerascens*, was based on specimens collected from bamboo in Misiones province, Argentina (Hjortstam & Ryvarden 1986). This species is saprophytic and is distributed in Argentina and Brazil (Hjortstam & Ryvarden 1986, 2007). The classification of *Gloeocorticium* in *Cyphellaceae, Marasmiineae*, *Agaricales, Agaricomycetidae, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* is in agreement in Species Fungorum, MycoBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

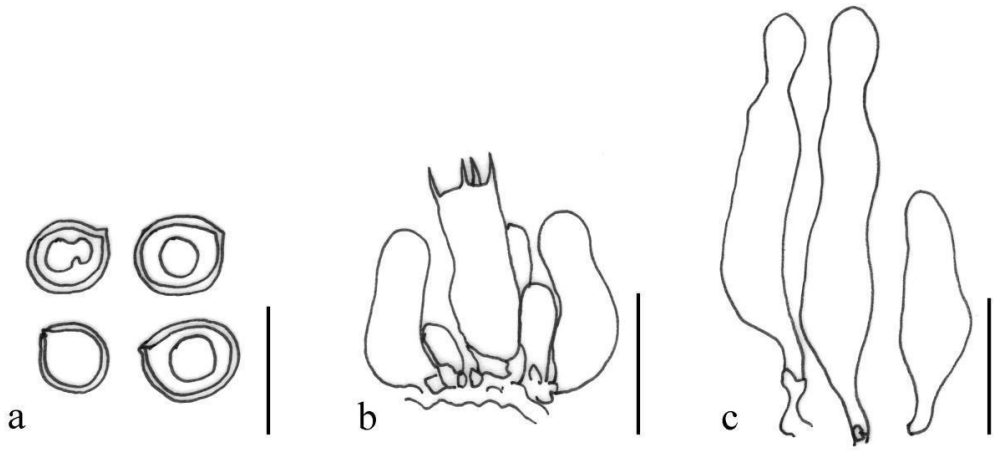


Fig. 43 – ***Gloeocorticium cinerascens***. a Basidiospores. b Basidia. c Cystidia. Scale bar: a = 5 µm, b–c = 10 µm. Redrawn from Hjortstam & Ryvarden (1986). For original basidiomata, refer to GBIF (2025).

Gloeocorticium is characterised by resupinate, adnate, effused, medium-thick basidiomata, with a more or less dry, firm hymenium (Hjortstam & Ryvarden 1986, Gorjón 2020). Basidiospores are subglobose, smooth, thick-walled, inamyloid, indextrinoid, acyanophilic, and have a distinct lateral apiculus. Basidia are clavate, with four sterigmata and a basal clamp. Gloeocystidia are moniliform, thin-walled, and amyloid. The hyphal system is monomitic to dimitic, with thin-walled, long-celled hyphae that are hyaline, smooth, inamyloid, and have clamp connections (Hjortstam & Ryvarden 1986, Gorjón 2020).

Species delineation of *Gloeocorticium* is based solely on macro- and micro-morphological characteristics, as no molecular sequences are available (Hjortstam & Ryvarden 1986, He et al. 2019). This genus is morphologically similar to *Radulomyces* M.P. Christ., sharing clavate basidia and ellipsoid basidiospores with a distinct apiculus. However, *Gloeocorticium* can be distinguished by its amyloid, moniliform gleocystidia, and laterally depressed basidiospores (Hjortstam & Ryvarden 1986).

Type species: *Gloeocorticium cinerascens* Hjortstam & Ryvarden

Cystostereaceae Jülich, Bibliotheca Mycologica 85, 362

Species Fungorum, Facesoffungi, MycoBank, GenBank

Classification: *Marasmiineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Cystostereaceae is a small family established by W. Jülich in 1982 with *Cystostereum* Pouzar as the type genus (Jülich 1982). Hyde et al. (2024a) lists 9 genera in *Cystostereaceae*: *Cericium* Hjortstam, *Crustomyces* Jülich, *Cystidiodontia* Hjortstam, *Cystostereum*, *Effusomyces* Yue Li, Nakasone & S.H. He, *Parvobasidium* Jülich, *Parvodontia* Hjortstam & Ryvarden, *Rigidotubus* J. Song, Y.C. Dai & B.K. Cui, and *Tenuimyces* S.L. Liu & L.W. Zhou. However, later Li et al. (2022a) conducted phylogenetic analyses (ITS and LSU) and recognised only four genera, *Crustomyces*, *Cystostereum*, *Effusomyces* Yue Li, Nakasone & S.H. He, and *Parvodontia*. Members of this family are characterised by effused to effused-reflexed basidiomata with smooth, odontoid, hydnoid, or poroid hymenium, monomitic or dimitic hyphal system, clamped generative hyphae, gloeocystidia or hyphidia, and smooth and inamyloid basidiospores. Members of *Cystostereaceae* are saprophytic on woody plants, causing white rot, and are distributed worldwide (Li et al. 2022a).

Parvobasidium Jülich, Persoonia 8(3), 302

Species Fungorum, Facesoffungi, MycoBank Fig. 44

Classification: *Cystostereaceae, Marasmiineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Parvobasidium is a small genus established by W. Jülich, with its type species *P. cretatum* (Jülich 1975, Li et al. 2022a). The type species was originally described as *Gloeocystidium cretatum*, based on specimens collected on rotten rachis of *Polystichum felix-femina* and *Polystichum spinulosum* in France (Bourdot & Galzin 1913, Jülich 1975). *Parvobasidium* is a wood-rotting genus with a widespread distribution, mainly across Europe, including the Netherlands, Spain, Portugal, and Italy (Stalpers 1985, Telleria & Duenas 1986, Saitta et al. 2011, He et al. 2019).

Species of *Parvobasidium* are characterised by resupinate basidiomata, which are effused, adnate, and membranous (Jülich 1975). The hymenial surface is smooth and cream-coloured (Jülich 1975). Basidiospores are smooth, hyaline, small, thin-walled, and inamyloid (Jülich 1975, Li et al. 2022a). Basidia are hyaline, small, and thin-walled and possess a basal clamp. Gloeocystidia are present and are hyaline and clavate (Jülich 1975). The hyphal system is monomitic, consisting of clamped generative hyphae (Jülich 1975, Li et al. 2022a). The hypha is hyaline and thin-walled (Jülich 1975).

Species delineation within *Parvobasidium* is based solely on macro- and micro-morphological characteristics due to the lack of molecular sequences (He et al. 2019). Stalpers

(1985) introduced another new combination, *P. lianicola*, based on a specimen originally classified as *Corticium lianicola* G. Cunn. Hyde et al. (2024a) have recognized only two species worldwide. The classification of *Parvobasidium* in Species Fungorum, MycoBank and Hyde et al. (2024a) is under *Cystostereaceae*, whereas UNITE lists it under *Hydnodontaceae* and may need updating.

Type species: *Parvobasidium cretatum* (Bourdot & Galzin) Jülich

Basionym: *Gloeocystidium cretatum* Bourdot & Galzin

Other accepted species: *P. lianicola* (G. Cunn.) Stalpers

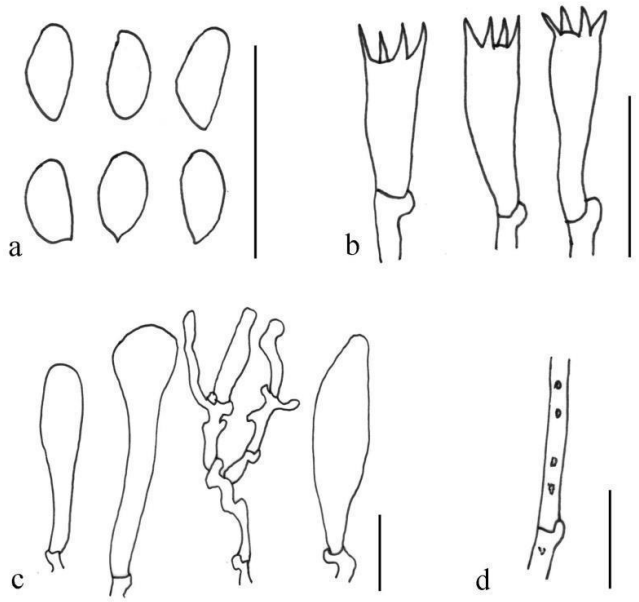


Fig. 44 – ***Parvobasidium cretatum***. a Basidiospores. b Basidia. c Gloeocystidia. d Hyphae with clamp connection. Scale bar: a–d = 10 µm. Redrawn from Jülich (1975). For original basidiomata, refer to Bancodesetas (2024).

Marasmiaceae Roze ex Kühner, Bulletin Mensuel de la Société Linnéenne de Lyon 49, 76

Species Fungorum, Facesoffungi, MycoBank, GenBank

Classification: *Marasmiineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota,* Fungi

Marasmiaceae was established by R. Kühner (1980), with *Marasmius* Fr. as the type genus (Kühner 1980). *Marasmiaceae* is the type family of suborder *Marasmiineae* Aime, Dentinger & Gaya (Dentinger et al. 2016, Oliveira et al. 2024). Hyde et al. (2024a) reported 5 genera in *Marasmiaceae*: *Chaetocalathus* Singer, *Crinipellis* Pat., *Marasmius*, *Moniliophthora* H.C. Evans, Stalpers, Samson & Benny, and *Paramarasmius* Antonín & Kolařík. *Marasmiaceae* is characterised by mostly small and thin, marcescent, or large, cyphelloid, marasmioid, campanelloid, or gymnopoid basidiomata with membranous, glabrous, velvet to pilose, dry, and white to strongly pigmented pileus (Oliveira et al. 2024). Hymenophore is whitish, smooth, or lamellate, with regular lamellae, fewer interveined to reticulate lamellae (Oliveira et al. 2024). Stipe can be none, short or well-developed, central to lateral, hollow, deeply pigmented-melanised, often chitinous, glabrous or pilose (Oliveira et al. 2024). Members of this family are distributed worldwide, and most are saprotrophic, while some are phytopathogenic (Oliveira et al. 2024).

Amyloflagellula Singer, Darwiniana 14, 14

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 45

Classification: *Marasmiaceae, Marasmiineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Amyloflagellula is a small genus within *Marasmiaceae* Roze ex Kühner, with *A. pulchra* designated as the type species. Originally, it was described as *Cyphella pulchra* Berk. & Broome, and later placed in *Marasmius* Fr. by Petch (1924) and *Lachnella* Fr. by Singer (1962d), until Singer (1966) established *Amyloflagellula* as a separate genus with distinct morphological features.

Members of *Amyloflagellula* are characterised by small cyphelloid or marasmioid basidiomata, which may be stipitate or non-stipitate, white rhizomorphs, and dextrinoid terminal cells of the subiculum (hypotrichium) with flagelliform projections (Singer 1966). In some features, *Amyloflagellula* resembles *Crinipellis* Pat. and *Chaetocalathus* Singer, but is differentiated by its narrow or occasionally absent lamellae and a short, curved stipe (Petch 1924, Dennis & Reid 1959, Agerer & Boidin 1981). Previously, *Amyloflagellula* included four species, all reported from Asia, Africa, and the Caribbean. For instance, *A. pulchra* was originally described from Sri Lanka and India (Petch 1924), and Japan (Kobayasi 1971). *Amyloflagellula pseudoarachnoidea* (Dennis) Singer, described from Trinidad (Dennis 1951), *A. verrucosa* Agerer & Boidin, and *A. inflata* Petch are known from Gabon, West Africa (Agerer & Boidin 1981).

Phylogenetic analyses based on multi-gene sequences conducted by Bodensteiner et al. (2004) and Oliveira et al. (2024) were the first to demonstrate *Amyloflagellula inflata* and *Hymenogloea papyracea* (Berk. & M.A. Curtis) Singer clusters within a clade of *Marasmius* species, indicating a close evolutionary relationship. This placement was further corroborated by Hyde et al. (2024a), strengthening their inclusion within the broader phylogenetic framework of *Marasmius*. At present, except for the type species, all other previously assigned species to these genera have now been placed under *Marasmius* (Oliveira et al. 2024). The classification of *Amyloflagellula* in *Marasmiaceae, Marasmiineae*, *Agaricales, Agaricomycetidae, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* is in agreement in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a). Currently, Species Fungorum (2026) lists two species of *Amyloflagellula*.



Fig. 45 – ***Amyloflagellula inflata***. a Basidiomata. b Pileipellis broom-cells. c Inflated to sub-inflated hyphae near the base of the basidiomata. d Basidiospores. e Star-shaped broom-cells of the subiculum. f Hymenial cystidia. Scale bars: a = 1 mm, b–f = 10 µm. Redrawn from Agerer & Boidin (1981) and Antonín (2003). For original basidiomata, refer to Antonín (2003).

Type species: *Amyloflagellula pulchra* (Berk. & Broome) Singer
Basionym: *Cyphella pulchra* Berk. & Broome
Other accepted species:
A. pseudoarachnoidea (Dennis) Singer

Chaetocalathus Singer, Lilloa 8, 518
Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 46
Classification: *Marasmiaceae, Marasmiineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota*, *Fungi*

Chaetocalathus was introduced by Singer in 1942, designating *C. craterellus* as its type species (Singer 1942a). These small agaric fungi exhibit a saprobic lifestyle (Singer 1942a). They are widely distributed and commonly grow on decaying wood, bark, sticks, stems, or leaf litter in forest environments (Antonin 2012, May et al. 2014). While most frequently found in tropical and subtropical regions, they occasionally occur in temperate zones (Antonin 2012, May et al. 2014). The geographic distribution of *Chaetocalathus* species is notable; species showing divided cystidia are found exclusively in the Eastern Hemisphere, whereas those with entire cystidia are primarily confined to the Western Hemisphere, indicating independent evolutionary paths (Singer 1942a). The classification of *Chaetocalathus* in *Marasmiaceae, Marasmiineae*, *Agaricales, Agaricomycetidae, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* is in agreement in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a). Currently, Species Fungorum (2026) lists 18 species of *Chaetocalathus*.

Members of *Chaetocalathus* are characterised by small, thin, delicate, pleurotoid basidiomata that are attached to the substrate either by the margin of the pileus or a rudimentary stipe (Antonin 2012). The pileus is white or pale, non-viscid, and often convex to campanulate (bell-shaped). It may attach directly to the substrate and is initially tomentose to scaly, often becoming glabrescent with age. The surface is covered with thick-walled hairs, which are amyloid or pseudoamyloid (Antonin 2012). These hairs are rather long, giving a distinct but somewhat variable reaction with iodine (Singer 1942a).

The lamellae are well-developed, converging either at an eccentric point or towards a rudimentary stipe (Singer 1942a). The stipe can be absent or rudimentary, appearing as a pseudostipe unconnected to the substrate and lacking its original function (Antonin 2012). The gills are white or pale, changing with maturity, free to slightly adnexed, often thin and well-spaced (Singer 1942a). The spore print is white to cream-colored (May et al. 2014). Clamp connections are present (May et al. 2014). The basidia are four-spored, occasionally 2-spored (Antonin 2012). Basidiospores are smooth or ornamented, hyaline, thin- or slightly thick-walled, dextrinoid, cyanophilic, ellipsoid to ovoid, and lack a germ pore (Antonin 2012, May et al. 2014). They may be pseudoamyloid or not, with pseudoamyloid predominating in species lacking pseudoamyloid cystidia or cheilocystidia. Many species have thick-walled pseudoamyloid cystidia or cheilocystidia that vary in form, appearing entire or divided, forked, spiny, or strongly incrusted (Singer 1942a). Cheilocystidia are always present, while pleurocystidia may be present or absent. Cystidia can be dextrinoid or non-dextrinoid (Antonin 2012).

Chaetocalathus is closely related to *Crinipellis* Pat., with both belonging to the family *Marasmiaceae* Roze ex Kühner (Antonin 2012). These genera are primarily distinguished by surface textures (with *Chaetocalathus* being more bristly) and by other morphological features, such as cystidial characteristics, a pleurotoid habit with a reduced stipe, and differences in spore morphology (Antonin 2012). The more advanced forms, characterised by numerous thick-walled cystidia, appear to be adaptations to tropical conditions (Singer 1942a). Additionally, the colourless crystals surrounding these cystidia are likely composed of calcium oxalate exudations (Singer 1942a).

Synonymy: *Crinipellis* Pat.
Type species: *Chaetocalathus craterellus* (Durieu & Lév.) Singer
Basionym: *Agaricus craterellus* Durieu & Lév.

Other accepted species: (Species Fungorum – search *Chaetocalathus*)

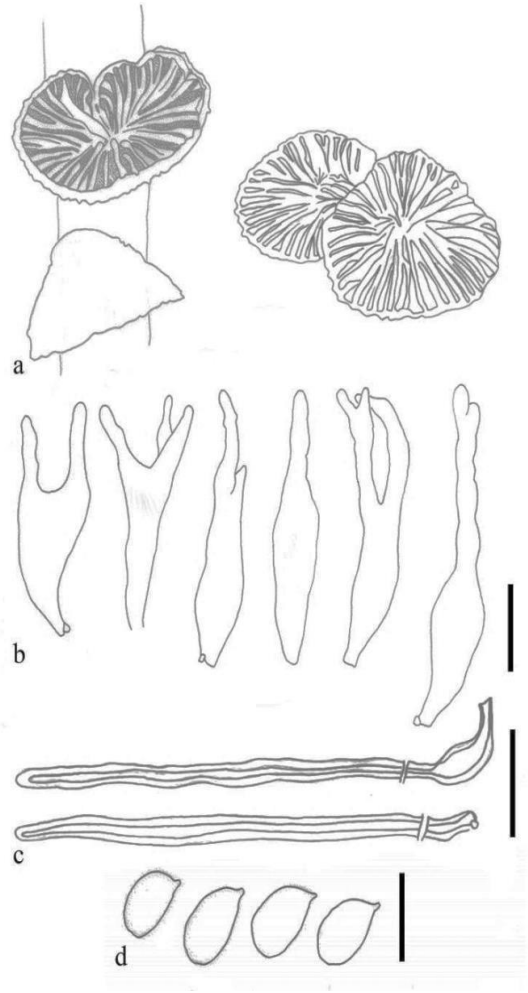


Fig. 46 – ***Chaetocalathus craterellus***. a Basidiomata. b Cheilocystidia. c Dextrinoid hairs of the pileipellis. d Basidiospores. Scale bars: b–d = 10 µm. Redrawn from: a = Domínguez (2020), b–d = Singer (1992).

Crinipellis Pat, Journal de Botanique (Paris) 3, 336

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 47

Classification: *Marasmiaceae, Marasmiineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Crinipellis are marasmioid or collybioid mushroom-forming fungi. The genus was established by Patouillard in 1889 with the type species *C. scabella* (Alb. and Schwein.) Murill (Singer 1942a, De Arruda et al. 2005, Li et al. 2023b).*Crinipellis* has a worldwide distribution with rich species diversity (Kerekes & Desjardin 2009, Li et al. 2023b). The classification of *Crinipellis* in *Marasmiaceae, Marasmiineae*, *Agaricales, Agaricomycetidae, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* is in agreement in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a). Currently, Species Fungorum (2026) lists 116 species of *Crinipellis*.

According to Singer (1986), *Crinipellis* was classified into five sections: *Crinipellis*, *Excentricinae*, *Grisentinae*, *Iopodinae*, and *Metuloidophorae* (Sharafudheen et al. 2023). Most species of *Crinipellis* are saprotrophic with wood and litter, among which some have useful beneficial applications (Sharafudheen et al. 2023). Molecular studies reported *Crinipellis* as a sister clade with *Chaetocalathus* Singer, *Moniliophthora* H.C. Evans, Stalpers, Samson and Benny, and *Marasmius* Fr. *sensu stricto* (Aime and Phillip-Mora 2005, Kerekes & Desjardin 2009).*Crinipellis*

basidiomata are characterised by a strigose, woolly to pilose, membranous to coriaceous pileus, which is formed by a trichoderm consisting of long hair-like, thick-walled, dextrinoid hyphae irregularly arising from a hypotrichium (Singer 1975, Kerekes & Desjardin 2009, de Oliveira & Hopkins 2019). Stipe is covered with thick-walled, dextrinoid, hair-like terminal cells (Xia et al. 2015, Li et al. 2023b). Lamellae are white to cream and free to adnate (Kerekes & Desjardin 2009, de Oliveira & Hopkins 2019). Latest studies used morphology and molecular phylogeny (ITS) for the identification of species of *Crinipellis* (Xia et al. 2015, Sharafudheen et al. 2023).

Some *Crinipellis* have potential antimicrobial activities. *Crinipellis rhizomaticola* showed fungicidal activity against *Magnaporthe oryzea* and *Colletotrichum coccodes* (Han et al. 2018a). A crinipellin, an antibiotic extracted from *Crinipellis stipitaria,* can be used to inhibit gram-positive bacteria (*Bacillus brevis)* (Kupka et al. 1979). However, species of *C. siparuanae*, *C. pseudostipitaria*, and *C. scabella* are known to be parasitic (Singer 1942a, Kerekes & Desjardin 2009, Li et al. 2023b).

Type species: *Crinipellis scabella* (Alb. & Schwein.) Murrill

Basionym: *Agaricus scabellus* Alb. & Schwein.

Other accepted species: (Species Fungorum – search *Crinipellis*)

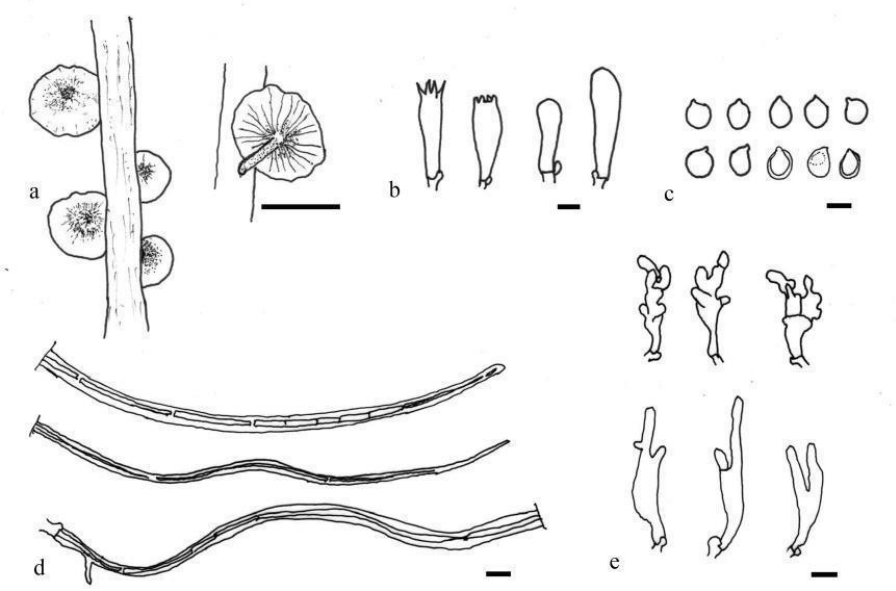


Fig. 47 – ***Crinipellis deutziae***. a Basidiomata. b Basidia and basidioles. c Basidiospores. d Pileus hairs. e Cheilocystidia. Scale bar: a = 5 mm, b−e = 10 µm. Redrawn from Li et al. (2023b).

Hymenogloea Pat., Essai Taxonomique sur les Hyménomycètes (Lons-le-Saunier), 146

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 48

Classification: *Marasmiaceae, Marasmiineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota*, *Fungi*

Initially, *Hymenogloea* was placed in *Thelephoraceae* Chevall. as per the classical morphology-based classification. But this placement was not supported by Patouillard (1900) and Singer (1949, 1959b). Singer (1949) rather classified *Hymenogloea* under the family *Cyphellaceae* Burnett. This was a significant departure from traditional taxonomic placements, as he reorganised many basidiomycete genera based on micromorphological and developmental characteristics. *Hymenogloea* is characterised by its large, bright coloured basidiomata with basal mycelium (Singer 1959b). The basidiomata are collybioid with a central stipe that resembles some stipitate species of *Stereum* Hill ex Pers. and *Marasmius* sect. *Sicci* Singer. But the absence of a lamellate hymenophore distinguishes *Hymenogloea*. The hymenium surface is smooth on the abaxial surface of the pileus. The pileipellis consists of swollen cells without any setulae and is completely devoid

of any dermatocystidia. Basidiospores are fusoid to cylindrical and inamyloid (Singer 1959b).

Hymenogloea is a distinctive genus characterised by its pigmented basidiomata, completely smooth hymenial surface, and thin pileus trama (Singer 1959b). Another striking character of this genus is the change in colour of basidiomata on dehydration and fading when treated with alkali. These characteristics separate it from all the similar genera (Singer 1959b). Previously, the genus comprised two species, *Hymenogloea riofrioi* (Pat.) Pat. and *H. papyracea* (Berk. & M.A. Curtis) Singer. Later, *H. papyracea,* which was once considered to have a smooth hymenium (Singer 1959b, 1960), was reassessed with defined hymenial folds and has been transferred to *Marasmius* (Halling & Mueller 2019, Kalichman et al. 2020). Thus, the genus has been placed within *Marasmiaceae* Roze ex Kühner, comprising the single species, *H. riofrioi*, native to tropical regions of the Americas (Singer 1949, 1959b). However, the generic status of *Hymenogloea* is doubtful due to the lack of phylogenetic analysis. It has been listed under "Questionably Accepted Names" and may be a synonym of *Marasmius* (Kalichman et al. 2020). Recently, the genus is placed as a synonym of *Marasmius* (Hyde et al. 2024a). The classification of *Hymenogloea* in *Marasmiaceae, Marasmiineae*, *Agaricales, Agaricomycetidae, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* is in agreement in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Type species: *Hymenogloea riofrioi* (Pat.) Pat.

Basionym: *Stereum riofrioi* Pat.



Fig. 48 – ***Hymenogloea***. Source: https://www.inaturalist.org/observations/163098238. The photo has been used under the CC BY 4.0 International non-commercial license.

Omphalotaceae Bresinsky, in Kämmerer, Besl & Bresinsky, Plant Systematics and Evolution 150(1–2), 113

Species Fungorum, Facesoffungi, MycoBank, GenBank

Classification: *Marasmiineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Omphalotaceae was established by A. Kämmerer, H. Besl & A. Bresinsky in 1985, with *Omphalotus* Fayod as the type genus (Kämmerer et al. 1985). *Omphalotaceae* is characterised by morphologically diverse marasmioid and gymnopoid agaric basidiomata (Oliveira et al. 2019). Hyde et al. (2024a) lists 20 genera in *Omphalotaceae*: *Anthracophyllum* Ces., *Caripia* Kuntze, *Collybiopsis* (J. Schröt.) Earle, *Connopus* R.H. Petersen, *Gymnopanella* Sand.-Leiva, J.V. McDonald & Thorn, *Gymnopus* (Pers.) Gray, *Hymenoporus* Tkalčec, Mešić & Chun Y. Deng, *Lentinula* Earle, *Mycetinis* Earle, *Neonothopanus* R.H. Petersen & Krisai, *Omphalotus*, *Paragymnopus* J.S. Oliveira, *Paramycetinis* R.H. Petersen, *Pseudomarasmius* R.H. Petersen &

K.W. Hughes, *Pusillomyces* J.S. Oliveira, and *Rhodocollybia* Singer. Members of this family are distributed worldwide and are saprotrophic or parasitic (Oliveira et al. 2019).

Lentinula Earle, Bulletin of the New York Botanical Garden 5, 416

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 49

Classification: *Omphalotaceae, Marasmiineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Lentinula was introduced by Earle in 1909 (Earle 1909), initially typified by *Lentinus cubensis* Berk. & M.A. Curtis, which later synonymised with *Lentinula boryana* (Berk. & M.A. Curtis) Pegler (Pegler 1975, Menolli Jr et al. 2022). Initially, *Lentinula* was considered a synonym of *Lentinus* Fr., but morphological differences in hyphal structure and type of wood rot types eventually established *Lentinula* as a distinct genus (Pegler 1983b, Redhead & Ginns 1985, Capelari et al. 2010). Phylogenetic analyses further supported this distinction. Species of this genus are wood-decaying white rot fungi found widely across Asia-Australasia, the Americas, and Madagascar. *Lentinula edodes* (Berk.) Pegler, commonly known as *shiitake* 'oak mushroom' in Japan or *xiang-gu* 'fragrant mushroom' in China, is one of the most cultivated edible mushrooms globally (Chen et al. 2016, Menolli Jr et al. 2022). The classification of *Lentinula* in *Omphalotaceae, Marasmiineae*, *Agaricales, Agaricomycetidae, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* agrees in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a). Species Fungorum (2026) lists 10 accepted species of *Lentinula,* worldwide.

The basidiomata of *Lentinula* are typically convex to applanate, fleshy, smooth, and glabrous when young, sometimes become squamose or fissured with maturity, and have entire or minutely serrulate edges (Pegler 1983b). Lamellae are adnate to adnexo-sinuate, initially free from the stipe, whitish at first, but discolouring to brownish or vinaceous as they mature, and are crowded. Stipe can be central or eccentric, cylindrical or compressed, and solid. Veils are cortinoid, fugacious, and typically remain on the pileus margin. The hyphal system is monomitic, characterised by inflated, sclerified generative hyphae, and exhibits constricted septa at clamp connections. Basidiospores are small, ovo-ellipsoid to ellipso-cylindric, hyaline, inamyloid, indextrinoid, thin-walled, and produce a white spore deposit. Pleurocystidia are absent (Pegler 1983b).

Hibbett & Vigalys (1993) conducted the first phylogenetic study on *Lentinula,* demonstrating its closer relationship to *Collybia* (Fr.) Staude than to *Lentinus*. Capelari et al. (2010) used both morphological and phylogenetic analysis (LSU) to identify *L. raphanica* (Murrill) J.L. Mata & R.H. Petersen. More recently, multi-gene phylogenetic analyses (ITS, LSU, and *tef1-α*), morphological characters, and mating compatibility have been used to delineate species within *Lentinula* (Menolli Jr et al. 2022). Advances in technology have also enabled the complete mitochondrial genome of this species to be determined using next-generation sequencing (Chen et al. 2016, Yang et al. 2017b).

Synonymy: *Shitaker* Lloyd

Type species: *Lentinula boryana* (Berk. & Mont.) Pegler

Basionym: *Lentinus cubensis* Berk. & M.A. Curtis

Other accepted species:

L. aciculospora J.L. Mata & R.H. Petersen
L. edodes (Berk.) Pegler
L. guarapiensis (Speg.) Pegler
L. guzmanii Menolli & J.L. Mata
L. ixodes (Secr. ex Mont.) J.S. Oliveira, T.S. Cabral, Vargas-Isla & N.K. Ishik.
L. lateritia (Berk.) Pegler
L. madagasikarensis Buyck, Randrianj. & Looney
L. novae-zelandiae (G. Stev.) Pegler
L. raphanica (Murrill) Mata & R.H. Petersen

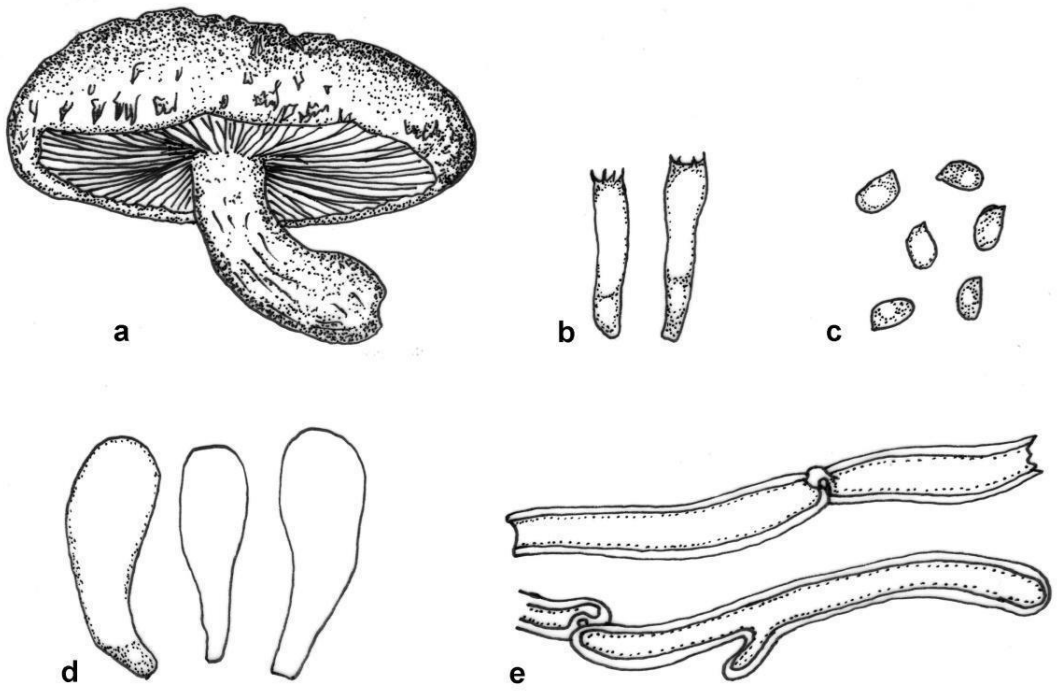


Fig. 49 – ***Lentinula edodes***. a Basidiomata (×1). b Basidia (×1000). c Basidiospores (×1000). d Cheilocystidia (×1000). e Context hyphae (×500). Redrawn from Pegler (1983b).

Physalacriaceae Corner, Beihefte zur Nova Hedwigia 33, 10

Species Fungorum, Facesoffungi, MycoBank, GenBank

Classification: *Marasmiineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Physalacriaceae was established by E.J.H. Corner (1970), with *Physalacria* Peck as the type genus (Corner 1970). He et al. (2024) and Hyde et al. (2024a) have recognised 32 genera recognised in this family worldwide. *Physalacriaceae* accommodates a wide range of basidiomata types: agaricoid, cantharelloid, clavarioid, secotioid, and corticoid basidiomata and is characterised by narrowly clavate basidia, thin-walled, smooth, ellipsoidal, cylindrical, fusiform, or lacrimiform basidiospores, and a monomitic hyphal system (Henkel et al. 2010, Moreau et al. 2015, Park et al. 2017). Molecular phylogenetic analyses confirmed monophyly in *Physalacriaceae* (Moncalvo et al. 2002, Matheny et al. 2006). Members of *Physalacriaceae* are distributed worldwide and are mainly saprobic, although some species are parasitic. Some members of this family are valuable edible mushrooms (*Flammulina velutipes* (Curtis) Singer), while some are forest pathogens (*Armillaria* (Fr.) Staude) (Park et al. 2017).

Anastrophella E. Horak & Desjardin, Australian Systematic Botany 7(2), 162

Species Fungorum, Facesoffungi, MycoBank Fig. 50

Classification: *Physalacriaceae, Marasmiineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota*, *Fungi*

Anastrophella was established by E. Horak & Desjardin in 1994, with *A. subpeltata* as the type species (Horak & Desjardin 1994). Species of *Anastrophella* are regarded as terrestrial and saprobic fungi. The etymological meaning of "*Anastrepho*" is turned upside down or inverted, referring to the alignment of the pileus to the stipe (Horak & Desjardin 1994). The monotypic taxon *Physalacria* section *Pileolina* Singer was established by Singer for *Physalacria subpeltata* Redhead, E. Horak & Desjardin (1994), and was later recombined as *A. subpeltata* (Singer 1976, Horak & Desjardin 1994). Morphologically, *Anastrophella* is characterised by nutant and minute basidiomata, with inverted-cupulate pilei and smooth basidiospores, a relatively long, central

pseudo-stipe, and a hymeniform pileipellis composed of smooth, vesiculose cells and pilocystidia. Basidiospores are ellipsoid or subfusiform, light in colour, hyaline, and inamyloid (Horak & Desjardin 1994).

Anastrophella is closely related to *Gloiocephala* Massee and *Physalacria* Peck (Horak & Desjardin 1994). Additionally, the basidiomata of *Hispidocalyptella* E. Horak & Desjardin are morphologically similar to those of *Anastrophella* species. However, *Anastrophella* can be distinguished by its hymeniform pileipellis composed of clavate or vesiculose cells and pilocystidia. The identification of *Anastrophella* species relies solely on macro- and micro-morphological characteristics, as no molecular evidence has been reported (He et al. 2019). The classification of *Anastrophella* in Species Fungorum and Hyde et al. (2024a) is under *Cantharellulaceae*, whereas MycoBank and UNITE list it under *Marasmiaceae* and may need updating. To date, the genus consists of three species worldwide (Hyde et al. 2024a).

Type species: *Anastrophella subpeltata* (Redhead) E. Horak & Desjardin

Basionym: *Physalacria subpeltata* Redhead

Other accepted species:

P. macrospora E. Horak & Desjardin

P. podocarpicola Issh. Tanaka

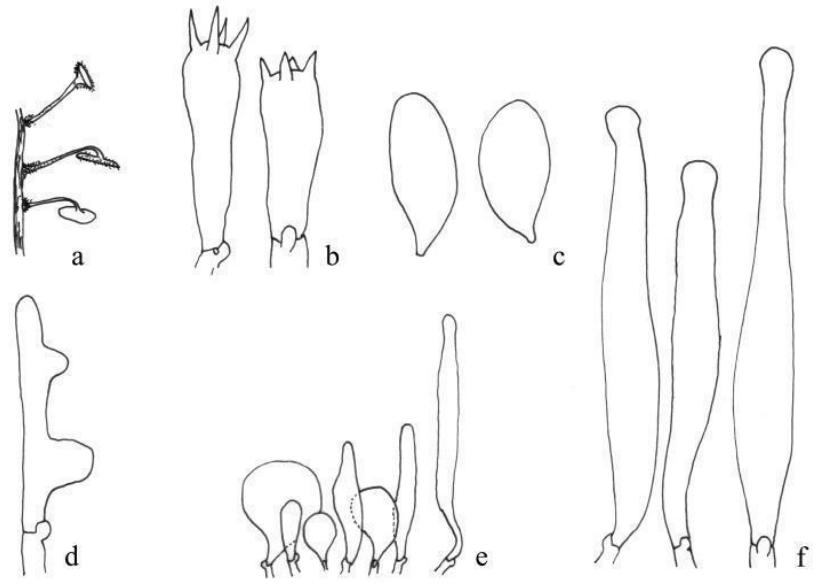


Fig. 50 – ***Anastrophella macrospora*** (PDD, holotype). a Basidiomata (×3). b Basidia (×1000). c Basidiospores (×2000). d Terminal cell of cortical hyphae of stipe (×1000). e Pileipellis with pilocystidia (×500). f Hymenial cystidia (×1000). Redrawn from Horak & Desjardin (1994).

Dactylosporina (Clémençon) Dörfelt, Feddes Repertorium Specierum Novarum Regni Vegetabilis 96, 236

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 51

Classification: *Physalacriaceae, Marasmiineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Dactylosporina belongs to the *Xerula*/*Oudemansiella* group of agaric fungi in the family *Physalacriaceae* Corner (Petersen & Hughes 2010). Clémençon first introduced *Dactylosporina* as a subgenus of *Oudemansiella* Locq. in 1979, and later Dörfelt (1985) elevated it to genus level, including *D. steffenii* (Rick) Dörfelt as the type species and *D. macracantha* (Singer) Dörfelt (Ushijima et al. 2015). Species of *Dactylosporina* are usually found on the ground and are distributed in Central and South America (Guyana, Colombia, and Brazil), Europe, and Japan (Petersen & Hughes 2010, Ushijima et al. 2015).

Basidiomata of *Dactylosporina* are usually small to medium-sized, collybioid, with a rooting

stipe (pseudorhiza) and a dark brown to orange-brown and viscid cap; the surfaces become sticky when wet in both the pileus and stipe (Petersen & Hughes 2010). Lamellae are white, marginate to dark brown (Ushijima et al. 2015). Basidiospores are globose to subglobose, spinulose, covered with long, finger-like spines (Petersen & Hughes 2010, Ushijima et al. 2015). It usually shows the presence of pileo-, caulo-, and cheilocystidia filled with oily content. Pleurocystidia are absent among all the species with clamp connections (Ushijima et al. 2015).

Dactylosporina forms a distinct clade from other members of the *Xerula/Oudemansiella* complex, both in morphology and molecular phylogeny, as demonstrated by Petersen & Hughes (2010). Ushijima et al. (2015) described a new species, *D. brunneomarginata*, based on morphological characteristics. The classification of *Dactylosporina* in *Physalacriaceae, Marasmiineae*, *Agaricales, Agaricomycetidae, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* is in agreement in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a). Species Fungorum (2026) lists 5 species of *Dactylosporina* worldwide.

Synonyms: *Oudemansiella* sect. *Dactylosporina* (Clémençon) Pegler & T.W.K. Young, *Oudemansiella* subgen. *Dactylosporina* Clémençon

Type species: *Dactylosporina steffenii* (Rick) Dörfelt

Basionym: *Tricholoma steffenii* Rick

Other accepted species:

D. brunneomarginata Ushijima, Nagas. & S. Kigawa

D. glutinosa (Singer) R.H. Petersen

D. kuehneri (Romagn.) R.H. Petersen

D. macracantha (Singer) Dörfelt

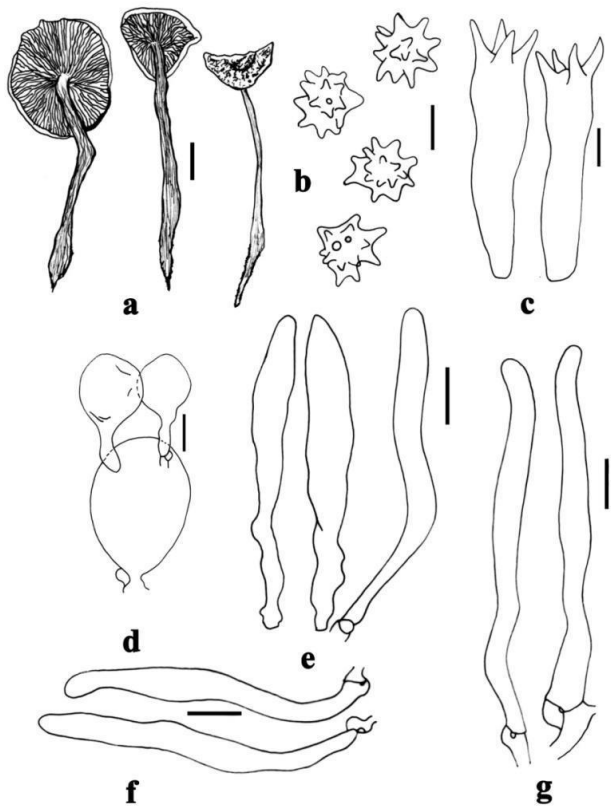


Fig. 51 – ***Dactylosporina brunneomarginata*** (HCM 58-4794, holotype). a Basidiomata. b. Basidiospores. c Basidia. d Pileocystidia. e Pileocystidia. f Cheilocystidia. g Caulocystidia. Scale bars: a = 1 cm, b–g = 10 μm. Redrawn from Ushijima et al (2015). For original basidiomata, refer to Ushijima et al (2015).

Epicnaphus Singer, Sydowia 14(1–6), 274, 279

Species Fungorum, Facesoffungi, MycoBank Fig. 52

Classification: *Physalacriaceae, Marasmiineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Epicnaphus was established by Rolf Singer to accommodate *E. phalaropes* as its type species (Singer 1960). The type specimen was collected from a fallen, dead branch of a dicotyledonous tree in the Bolivian rainforest. Subsequently, *E. longispora* was introduced by Raithelhuber in 1973 (Patouillard & Gaillard 1888). *Epicnaphus* species are primarily found in South America, including Argentina (He et al. 2019).

Epicnaphus species exhibit distinct mycenoid-stereoid basidiomata with a centrally stipitate structure, a smooth hymenial surface, and basal mycelium (Singer 1960). Both the pileus and the stipe are pigmented, and the epicutis of the pileus has a hymeniform to subhumeniform structure composed of clavate or clavate-subvesiculose elements. The upper portion features thin, diverging rotalis-type setulae. Basidiospores are ellipsoid, medium-sized, and inamyloid, while dermatocystidia and hymenial cystidia are absent. The hyphae are non-gelatinised and pseudoamyloid (Singer 1960).

The identification of *Epicnaphus* species was based on macro- and micro-morphological characteristics due to a lack of molecular data (He et al. 2019). He et al. (2019) and Hyde et al. (2024a) recognise only two species worldwide. The genus is thought to be closely related to *Marasmius* section *Sicci* Singer. It differs by its smooth hymenial surface and the presence of rotalis-type setulae among epicuticular elements (Singer 1960). Additionally, the stipe of *Epicnaphus* species is either institious, rhizomorphic, or directly attached to the substratum, further distinguishing them from other species in the section (Singer 1960). The classification of *Epicnaphus* in Species Fungorum, and Hyde et al. (2024a) is under *Physalacriaceae*, whereas MycoBank lists it under *Marasmiaceae* and may need updating.

Type species: *E. phalaropus* Singer

Other accepted species:

E. longispora Raithelh.

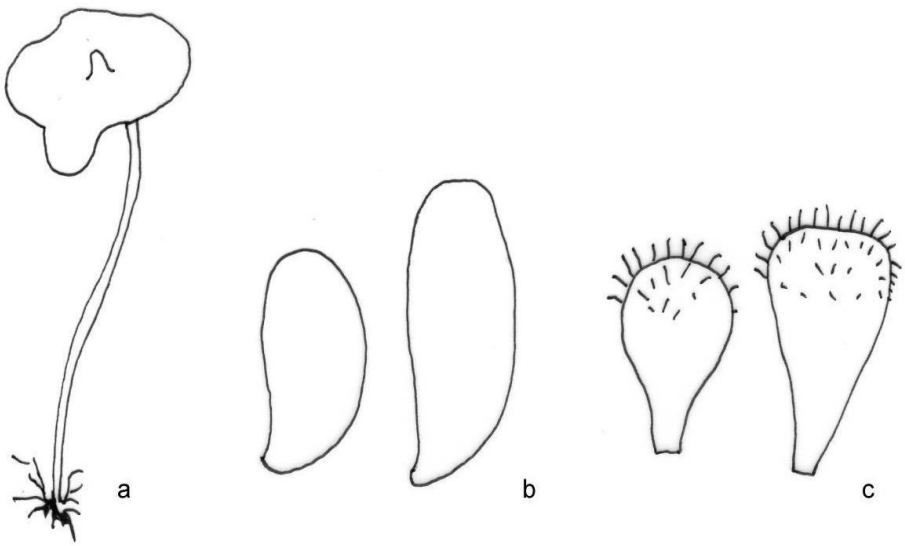


Fig. 52 – ***Epicnaphus phalaropus***. a Basidiomata (×4). b Basidiospores (×2000). c Epicuticular broom cells (×1000). Redrawn from Singer (1960).

Flammulina P. Karst., Meddelanden af Societas pro Fauna et Flora Fennica 18, 62

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 53

Classification: *Physalacriaceae, Marasmiineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Flammulina was established in 1891 by Petter Adolf Karsten. *Flammulina,* which includes edible mushrooms, is cosmopolitan in distribution and typically found in deciduous forests (Ge et al. 2008). *Flammulina velutipes* (Curtis) Singer, commonly known as "*Enokitake*", is recognised for its nutritional and medicinal properties and is one of the most widely cultivated mushrooms worldwide (Ge et al. 2008). Initially, *Flammulina* was considered a monotypic genus until *F. ononidis* Arnolds was separated from *F. velutipes* (Arnolds 1977, Ge et al. 2008). Subsequently, the use of different techniques, such as mating studies, restriction fragment length polymorphism (RFLP) patterns, and phylogenetic studies (combined ITS, *tef1-α*, *rpb2*, and HD1) led to the identification of different species (Bas 1983, Hughes et al. 1999, Petersen et al. 1999, Methven et al. 2000, Ge et al. 2008, Ge et al. 2015, Wang et al. 2018). *Flammulina* species are characterised by a smooth, sticky pileus that is viscid when wet, yellowish lamellae that are adnate to adnexed, inamyloid basidiospores, and a suprapellis consisting of a hymeniform or palisadic layer over a gelatinised hypodermium interspersed with pilocystidia (Ge et al. 2015).

Regarding medicinal properties, a new group of antimicrobial compounds, enokipodins A, B, C, and D, has been produced from the mycelium culture of *F. velutipes* (Ishikawa et al. 2005). Furthermore, *F. velutipes* is renowned for its anti-cancer properties (Wang et al. 2018). The classification of *Flammulina* in *Physalacriaceae, Marasmiineae*, *Agaricales, Agaricomycetidae, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* is in agreement in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a). Currently, Species Fungorum (2026) lists 17 species of *Flammulina*.

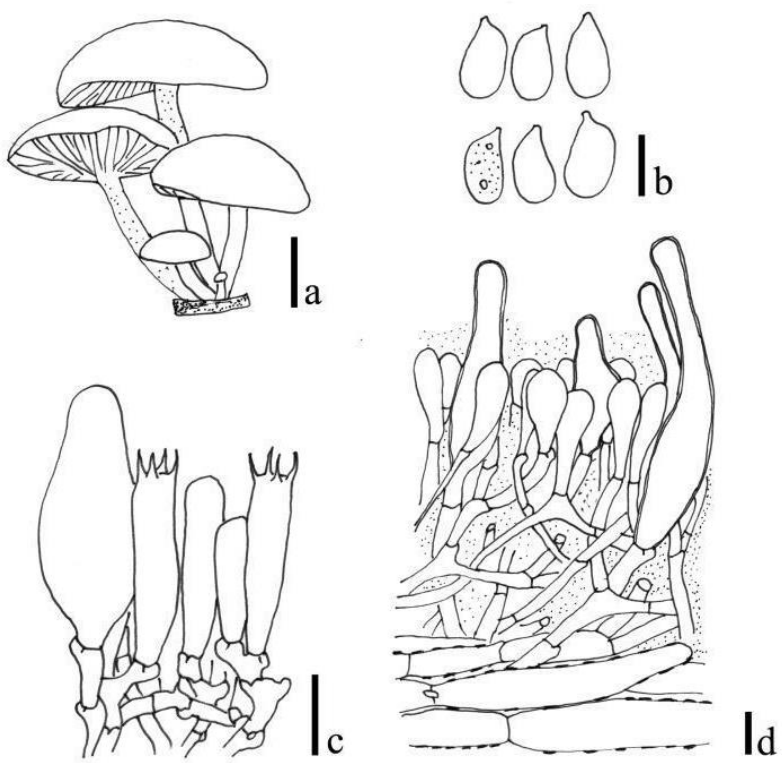


Fig. 53 – ***Flammulina yunnanensis*** (HKAS41344, holotype). a Basidiomata. b Basidiospores. c Subhymenium and hymenium with pleurocystidia and basidia. d Radial section of pileipellis. Scale bar: a = 1 cm, b = 5 μm, c–d = 10 μm. Redrawn from Ge et al. (2008).

Synonymy: *Collybidium* Earle, *Myxocollybia* Singer, *Myxocollybia* Singer
Type species: *Flammulina velutipes* (Curtis) Singer
Basionym: *Agaricus velutipes* Curtis

Other accepted species: (Species Fungorum – search *Flammulina*)

Manuripia Singer, Sydowia 14(1–6), 273, 279

Species Fungorum, Facesoffungi, MycoBank Fig. 54

Classification: *Physalacriaceae, Marasmiineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Manuripia is a monotypic genus established by Rolf Singer, with *M. bifida* as the type species (Singer 1960, Hyde et al. 2024a). The specimen was collected from a dead fallen woody stick of a dicotyledonous plant in the rainforest in Bolivia. *Manuripia* is characterised by centrally stipitate and pileate basidiomata, a hymenial surface that is smooth or with few low veins, and pigmentation on the pileus and stipe. The epicutis of pileus consists of balloon-shaped elements with short divergent setulae. Hymenial cystidia are absent in *Manuripia*. Basidiospores are ellipsoid and inamyloid. Hyphae are inamyloid. Stipe is sometimes branched and arises from rhizomorphs (Singer 1960).

Manuripia roughly corresponds to section *Hygrometrici* of *Marasmius* Fr., but it differs in having rhizomorphigenous stipes that may be branched and in the absence of lamellae (Singer 1960). *Manuripia* differs from section *Marasmius* in the absence of collarium, as well as the combination of smooth, flat pileus and inamyloid hyphae. Additionally, *Manuripia* differs from both these sections in the crust-like aggregation of the setulae of the epicuticular broom cells. No molecular evidence is available for *Manuripia* (He et al. 2019). The classification of *Manuripia* in Species Fungorum and Hyde et al. (2024a) is under *Physalacriaceae*, whereas MycoBank and UNITE list it under *Marasmiaceae* and may need updating.

Type species: *Manuripia bifida* Singer

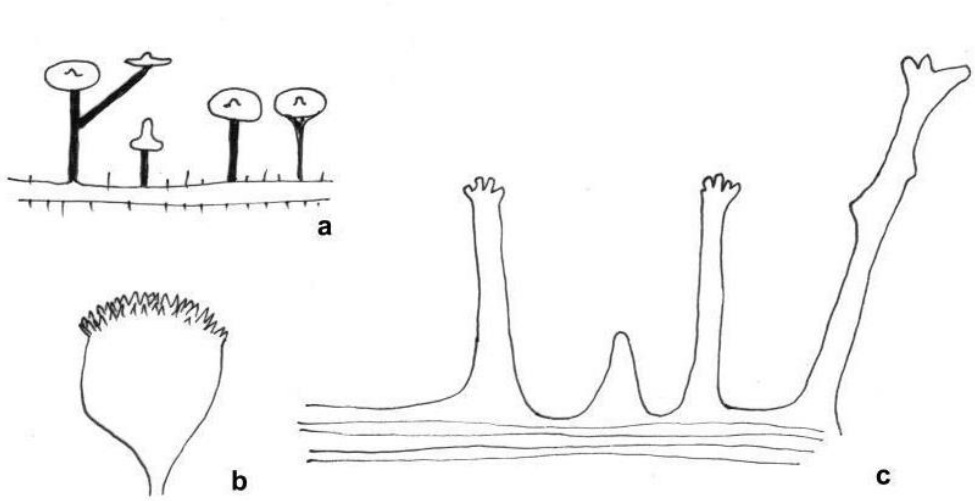


Fig. 54 – ***Manuripia bifida***. a Basidiomata (×4). b Element of epicutis (×1000). c Rhizomorph (×1000). Redrawn from Singer (1960).

Physalacria Peck, Bulletin of the Torrey Botanical Club 9(1), 2

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 55

Classification: *Physalacriaceae, Marasmiineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota*, *Fungi*

Physalacria, the type genus of *Physalacriaceae* Corner, was established by C.H. Peck (1882) with *Physalacria inflata* as the type species (Peck 1882, Kirk et al. 2008). The type species was described as *Mitrula infalta* from specimens collected on bark in South Carolina, USA (Peck 1882). The genus was initially placed in *Clavariaceae* Chevall. (Clements & Shear 1931, Baker 1941, Corner 1950) or *Thelephoraceae* Chevall. (McGuire 1939), and later, the genus was reclassified as *Physalacriaceae* (Berthier 1985). Members of *Physalacria* are saprotrophic on several tree species,

including *Cryptomeria*, *Podocarpus*, and bamboos (Qin & Yang 2016). *Physalacria* are distributed worldwide, including Africa, Asia, Europe, North America, South America, and Oceania (Qin & Yang 2016, He et al. 2019, Liu et al. 2025). Species Fungorum (2026) lists 39 species of *Physalacria*.

Members of *Physalacria* are characterised by small (shorter than 1 cm), stipitate-cespitose, geotropic basidiomata, with globose to subconical, hollow, fertile heads borne on a central sterile stipe (Inderbitzin & Desjardin 1999, Qin & Yang 2016). The hymenium is smooth on the surface of the heads (Qin & Yang 2016). Basidiospores are smooth and inamyloid, and clamp connections are abundant (Baker 1941, Corner 1950, Berthier 1985, Liu et al. 2025).

Li & Bau (2024) described a new species from China, *P. jilinensis* T. Bau & S.Y. Li, based on ITS and LSU genes, along with the morphological characteristics. Liu et al. (2025) published another new species, *P. tianzhongshanensis* A. Tohtirjap, L.R. Zhang & F. Wu. Phylogenetic analysis indicated that *Physalacria* is closely related to the corticioid genus *Cylindrobasidium* Jülich (Dentinger & McLaughlin 2006, Qin & Yang 2016). The classification of *Physalacria* in *Physalacriaceae, Marasmiineae*, *Agaricales, Agaricomycetidae, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* agrees in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Synonymy: *Baumanniella* Henn., *Eoagaricus* L. Krieg., *Hormomitaria* Corner

Type species: *Physalacria inflata* (Fr.) Peck

Basionym: *Mitrula inflata* Fr.

Other accepted species: (Species Fungorum – search *Physalacria*)

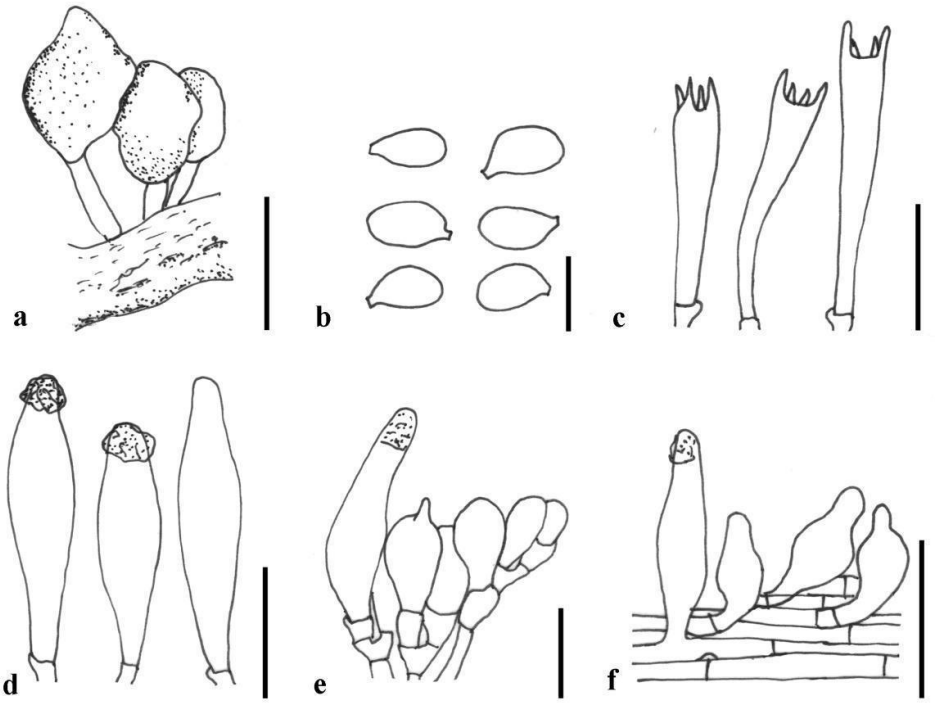


Fig. 55 – ***Physalacria jilinensis***. a Basidiomata. b Basidiospores. c Basidia. d Hymenial cystidia. e Sterile part of the hymenium. f Stipitipellis and caulocystidia. Scale bar: a = 2 mm, b = 5 µm, c = 10 µm, d–e = 20 µm, f = 30 µm. Redrawn from Li & Bau (2024). For original basidiomata, refer to Li & Bau (2024).

Strobilurus Singer, Persoonia 2(3), 409

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 56

Classification: *Physalacriaceae, Marasmiineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Strobilurus was established by R. Singer in 1962, and its type species is *S. conigenoides* (Singer 1962a). This species was originally described from specimens collected from decaying fruit of *Magnolia* in New Jersey, USA (Singer 1962a). Species of *Strobilurus* are saprotrophic and exhibit substrate specificity, growing on buried cones or wood of various *Pinaceae* and angiosperm trees, as well as on seed pods or fruits, including those of *Magnolia* and *Liquidambar* (Wells & Kempton 1971, Redhead 1980, Wani et al. 2021, Singh et al. 2023). These fungi are distributed across subtropical and temperate regions in Asia, Europe, and North America (Qin et al. 2018, He et al. 2019). Currently, Species Fungorum (2026) lists 16 species of *Strobilurus* worldwide.

Strobilurus is characterised by collybioid basidiomata with adnexed to almost free lamellae (Wani et al. 2021). The stipe bears a long tapering rooting base or pseudorhiza and lacks a veil. Basidiospores are smooth, thin-walled, non-amyloid, and white in deposit. Both hymenial cystidia and dermatocystidia are present in the cortical layers of the pileus and stipe (Wani et al. 2021). Additionally, the hyphal system lacks clamp connections (Wani et al. 2021, Singh et al. 2023).

In phylogenetic analyses, *Strobilurus* formed a sister group to *Xerula* Maire or *Marasmius epiphyllus* (Pers.) Fr. (Vizzini et al. 2013, Hao et al. 2014, Qin et al. 2014). Qin et al. (2018) conducted genus-specific morphological and phylogenetic analyses of *Strobilurus* species, using ITS, LSU, *rpb2*, *tef-1α*, and *tub1* markers. These analyses also examined geographical distribution, associated host trees, basidiospore sizes, and the shape of pleurocysticia (Qin et al. 2014).

The classification of *Strobilurus* in *Physalacriaceae, Agaricales, Agaricomycetidae, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* is in agreement in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

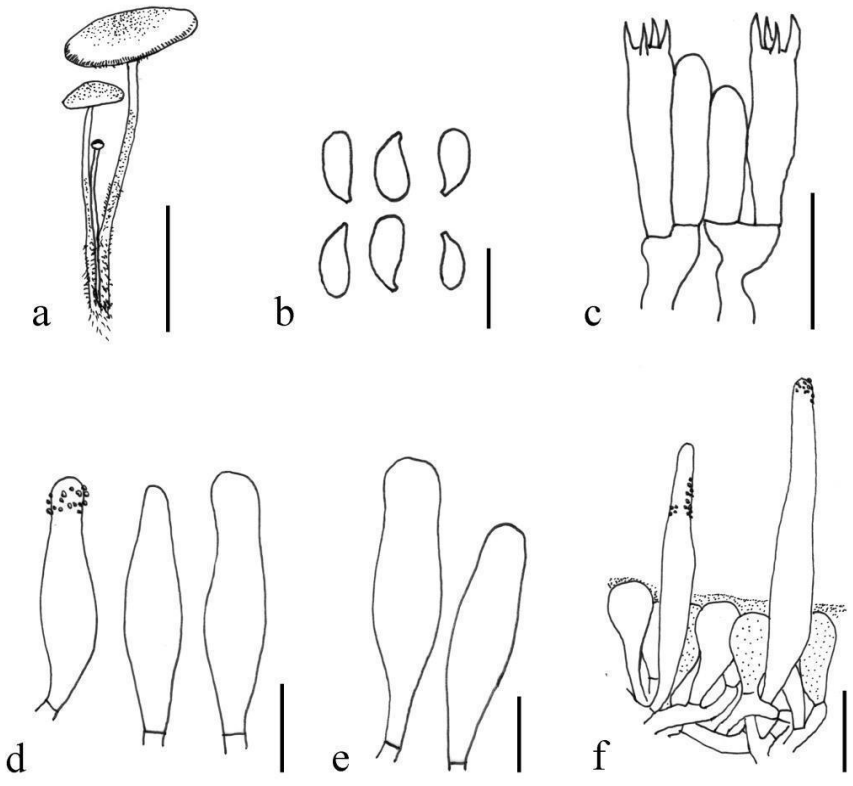


Fig. 56 – ***Strobilurus orientalis*** (HKAS 54522, holotype). a Basidiomata. b Basidiospores. c Basidia and basidioles. d Pleurocystidia. e Cheilocystidia. f Pileipellis and pileocystidia. Scale bar: a = 3 cm, b = 5 μm, c–e = 10 μm, f = 20 μm. Redrawn from Qin et al. (2018). For original basidiomata, refer to Qin et al. (2018).

Species of *Strobilurus* have a wide range of applications, including the production of secondary metabolites and agricultural fungicides. For instance, *Strobilurus ohshimae*, a wild

edible mushroom from Japan, has been a source of sesquiterpenoids known as strobilols A–D (Hiramatsu et al. 2007). Species such as *S. tenacellus* exhibit strong antifungal activity and are extensively utilised in producing broad-spectrum strobilurin fungicides (quinone oxidase inhibitors) (Anke et al. 1977, Bartlett et al. 2002, Balba 2007, Serra et al. 2023). For instance, strobilurins A and B show high resistance to yeasts and filamentous fungi (Anke et al. 1977). Additionally, a new sesquiterpenoid, strobiluric acid, has been isolated from *S. stephanocystis* (Hiramatsu et al. 2007).

Type species: *Strobilurus conigenoides* (Ellis) Singer

Basionym: *Agaricus conigenoides* Ellis

Other accepted species: (Species Fungorum – search *Strobilurus*)

Porotheleaceae Murrill, Mycologia 8(1), 56

Species Fungorum, Facesoffungi, MycoBank, GenBank

Classification: *Marasmiineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Porotheleaceae was introduced by Murill in 1916 and typified with *Porotheleum* Fr (Na et al. 2024). Except for the type genus, most of the taxa in the family are characterized by collybioid, omphalinoid, or clitocyboid basidiomata, with either partly or completely pigmented pileus, adnexed to subdecurrent lamellae, smooth and thin-walled basidiospores, or presence of sarcodimitic tramal tissues (Singer 1951, Redhead 1987, Hughes et al. 2007, Senanayake et al. 2023, Na et al. 2024). Before phylogenetic studies, *Porotheleaceae* was treated as a 'hydropoid' clade within the 'marasmioid' clade. But multigene phylogenetic analyses, using different markers (ITS, LSU, *rpb1*, and *rpb2*), aid in establishing the hyropoid clade and the discovery of many new genera representing the single lineage of *Porotheleaceae* (Na et al. 2024). Currently, this family consists of 18 genera: *Acanthocorticium* Baltazar, Gorjón & Rajchenb., *Calyptella* Quél., *Chrysomycena* Vizzini, Picillo, Perrone & Dovana, *Clavomphalia* E. Horak, *Clitocybula* (Singer) Singer ex Métrod, *Delicatula* Fayod, *Gerronema* Singer, *Hydropodia* Vizzini & Consiglio, *Hydropus* Kühner ex Singer, *Leucoinocybe* Singer ex Antonín, Borovička, Holec & Kolařík, *Marasmiellomycena* De la Peña-Lastra, Mateos, Kolařík, Ševčíková & Antonín, *Megacollybia* Kotl. & Pouzar, *Porotheleum*, *Pseudohydropus* Vizzini & Consiglio, *Pulverulina* Matheny & K.W. Hughes, *Trogia* Fr., *Vanromburghia* Holterm., and *Vizzinia* Ševčíková & Kolařík (Hyde et al. 2024a). Members of the family are saprotophic in nature, mostly wood-decaying with agaricoid habitat, while a few are cephaloid and are distributed in subtropical to tropical regions (Singer 1951, Hughes et al. 2007, Senanayake et al. 2023, Na et al. 2024).

Calyptella Quél., Enchiridion Fungorum in Europa Media et Praesertim in Gallia Vigentium, 216

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 57

Classification: *Porotheleaceae, Marasmiineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Calyptella was established by Licien Quélet in 1886, although no type species was indicated (Quélet 1886). In 1951, M.A. Donk designated *C. capula* (Holmsk.) Quél. as the type species, based on a specimen collected in Sweden (Donk 1952). Species within the genus *Calysptella* are worldwide distributed and are primarily saprobic (He et al. 2019).

Calyptella is characterised by its delicate, stipitate-cupulate, wine-glass-shaped basidiomata (Reid 1961). To the unaided eye, these appear smooth, but under magnification, they are often sparsely and minutely tomentose. The basidiospores are elliptical to pip-shaped, hyaline or subcylindrical. Its hyphal system is monomitic, composed of thin-walled, branched, hyaline generative hyphae that are inflated and clamped. The outermost hyphae develop small, wart-like swellings along their length, which extend into well-developed, highly branched coralloid structures that cover the external surfaces of the basidiomata (Reid 1961).

Bodensteiner et al. (2004) combined morphological characteristics with phylogenetic analyses (ITS and LSU) to delineate species within *Calyptella*. Currently, Species Fungorum (2026) lists 31 species of *Calyptella*. The classification of *Calyptella* in GenBank, He et al. (2024),

and Hyde et al. (2024a) is under *Porotheleaceae*, whereas Species Fungorum and MycoBank list it under *incertae sedis* and *Marasmiaceae*, respectively and may need updating.

Species of *Calyptella* are similar to *Stigmatolemma* Kalchbr. and *Resupinatus* Nees ex Gray in the general branching pattern of the surface hyphae. However, it is distinguished from these genera by the slight gelatinous character of its basidiomata and the absence of globule-bearing structures (Bodensteiner et al. 2004).

Calyptella campanula has a significant economic impact by causing substantial yield losses in tomato (*Lycopersicon esculentum*). Root rot disease in glasshouse-grown tomatoes was first reported in northern England in 1983 (Sandys-Winsch & Jeves 1992). Additionally, it is known to grow on the stem bases of herbaceous plants across Europe, Russia, and the USA (Cooke 1961, Sandys-Winsch & Jeves 1992).

Type species: *C. capula* (Holmsk.) Quél.

Basionym: *Peziza capula* Holmsk.

Other accepted species: (Species Fungorum – search *Calyptella*)

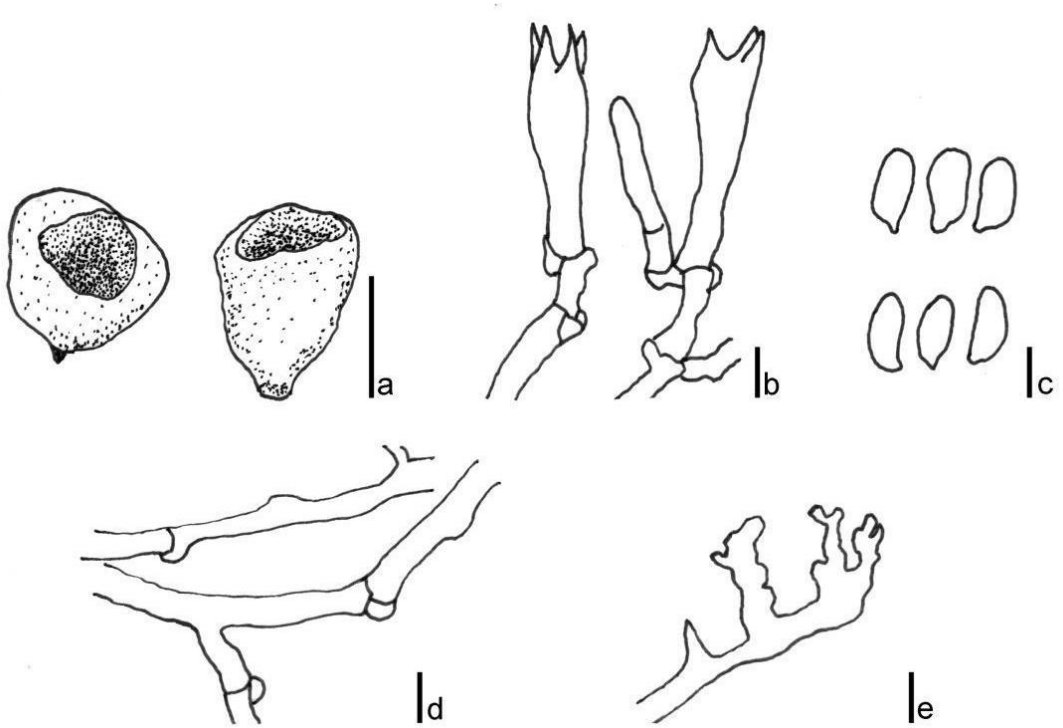


Fig. 57 – ***Calyptella capula*** (HCCN00010). a Basidiomata. b Basidia. c Basidiospores. d Generative hyphae. e Hyphal end of a generative hyphae. Scale bar: a = 1 mm, b–e = 5 μm. Redrawn from Lee et al. (2009).

Clitocybula (Singer) Singer ex Métrod, Revue de Mycologie 17(1), 74

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 58

Classification: *Porotheleaceae, Marasmiineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota*, *Fungi*

Singer (1943) initially classified *Clitocybula* as a subgenus of *Fayodia* Kühner; later, Métrod (1952) raised it to the genus level (Antonín et al. 2012). *Clitocybula* is typically distinguished by its frequent, thick-walled, broad hyphae, the presence of pilocystidia, the absence of pleurocystidia, and a cellular hypoderm. *Clitocybula* species are saprobic in wood and forest debris (Bigelow 1973). The genus is primarily found in temperate regions, including Austria, the Czech Republic, France, Slovakia, Sweden, and Switzerland in Europe, as well as in North America (Antonín et al. 2012).

Clitocybula includes basidiomata that are small to medium in size (Métrod 1952). The pileus is typically smooth to slightly scaly with a convex to bell-shaped form. Lamellae are decurrent, extending down the stipe. The stipe is usually white to pale, cylindrical, and uniformly wide along its length (Antonín et al. 2019). The hyphal system is monomitic, consisting solely of generative hyphae. Basidiospores are usually amyloid, ellipsoid to nearly spherical, smooth, and hyaline (Métrod 1952, Singer 1943, Antonín et al. 2019).

Some taxa previously classified under *Clitocybula* have been reclassified to other genera due to recent taxonomic revisions (Antonín et al. 2012). Antonín et al. (2019) reported *Megacollybia* Kotl. & Pouzar and *Leucoinocybe* Singer ex Antonín are now considered separate genera. This study provided detailed insights into the morphological characteristics, distribution patterns, and molecular phylogenetic analyses of *Clitocybula* and related genera.

Molecular phylogenetic analysis suggests that *Clitocybula* is closely related to *Porotheleaceae* Murrill, including *Hydropus* Kühner ex Singer, *Gerronema* Singer, and *Lignomphalia* Antonín, Borovička, Holec & Kolařík (Na et al. 2024). In addition, *Clitocybula* is morphologically similar to other genera in *Strophariaceae* Singer & A.H. Sm., such as *Stropharia* (Fr.) Quél. and *Hypholoma* (Fr.) P. Kumm. (Vizzini et al. 2024), particularly in wood-decaying habits and features like closely spaced gill attachment and basidiospores that are white to pale when young but darken with maturity. However, *Clitocybula* produces smaller and more delicate basidiomata compared to these genera (Gibson 2011). To better understand the evolutionary relationships among these genera, studies have analysed DNA sequences of the ITS and LSU regions (Antonín et al. 2019).

The classification of *Clitocybula* in GenBank and Hyde et al. (2024a) is under *Porotheleaceae*, whereas Species Fungorum and UNITE list it under *incertae sedis* and may need updating. Currently, Species Fungorum (2026) lists 21 species of *Clitocybula*.

Synonym: *Fayodia* subgen. *Clitocybula* Singer

Type species: *Clitocybula lacerata* (Scop.) Métrod, Revue Mycol., Paris 17(1): 74 (1952)

Basionym: *Agaricus laceratus* Scop., Fl. carniol., Edn 2 (Wien) 2: 439 (1772)

Other accepted species: (Species Fungorum – search *Clitocybula*)

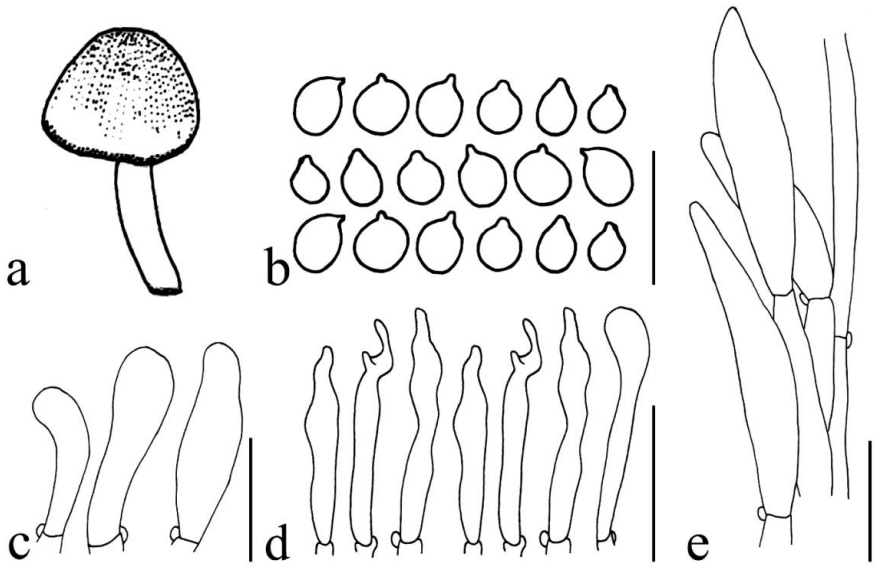


Fig. 58 – ***Clitocybula familia***. a Basidiomata. b Basidiospores. c Caulocystidia. d Marginal cells. e Pileipellis. Scale bars: b = 10 µm, c–d = 20 µm, e = 50 µm. Redrawn from Antonín et al. (2012). For original basidiomata, refer to Antonín et al. (2011).

Xeromphalinaceae Vizzini, Consiglio & P. Alvarado, Vizzini, Alvarado, Consiglio, Marchetti & Xu, Studies in Mycology 107, 96

Species Fungorum, Facesoffungi, MycoBank

Classification: *Marasmiineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Xeromphalinaceae was recently segregated from *Tricholomataceae sensu lato* to accommodate a distinct lineage of xeromphalinoid agarics supported by both morphological and molecular evidence (Vizzini et al. 2024). Early molecular analyses recovered *Xeromphalina* in different phylogenetic positions, including associations with the hygrophoroid clade and early-diverging lineages related to *Marasmiineae* and *Schizophyllineae*, leading several authors to regard the genus as *incertae sedis* (Lodge et al. 2014, Olariaga et al. 2020, Sánchez-García et al. 2020). Presently, the family includes two genera, *Xeromphalina* Kühner & Maire and *Heimiomyces* Singer (Vizzini et al. 2024, Hyde et al. 2024a). *Xeromphalinaceae* is distinguished by a combination of morphological traits, including an omphalinoid to marasmioid or collybioid habit, basidiomata with bright yellow-brown to rusty-brown colouration, a conspicuous yellowish-brown tomentum with radiating hairs at the stipe base, abundant encrusting epiparietal pigments in pileipellis elements, nondextrinoid trama hyphae, a sarcodimitic stipe trama, and the frequent presence of well-developed, armillarioid rhizomorphs (Miller 1968, Singer 1986, Aldrovandi et al. 2015, Vizzini et al. 2024). Species of the family are saprotrophic on conifers and are distributed mainly in temperate regions of both hemispheres and alpine zones (Vizzini et al. 2024).

Xeromphalina Kühner & Maire, in Konrad & Maublanc, Icones Selectae Fungorum 6, 236

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 59

Classification: *Xeromphalinaceae, Marasmiineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Xeromphalina was established by Kühner and Maire in 1934 to accommodate a small omphalioid mushroom, with *X. campanella* as the type species (Kühner & Maire 1934). The taxonomic placement for this genus has undergone several revisions from initial classification in the tribe *Marasmiaceae* Roze ex Kühner (Kühner 1980) and later, transferred to the family *Tricholomataceae* R. Heim ex Pouzar (Singer 1986, Moncalvo et al. 2002, Matheny et al. 2006). This genus was reclassified under *Mycenaceae* Overeem (Antonín & Bitak 2013, He et al. 2019) and subsequently in *Xeromphalinaceae* (Vizzini et al. 2024, Hyde et al. 2024a). In 1968, *Xeromphalina* was divided into three sections: *Xeromphalina* (Singer) O.K. Miller, *Fulvipes* O.K. Miller, and *Heimiomyces* (Singer) A.H. Smith (Miller 1968). However, Redhead adopted Singer's classification, which lists two subgenera: *Xeromphalina* subg. *Xeromphalina* Singer and subg. *Heimiomyces* (Singer 1962c, Redhead 1988). Species of *Xeromphalina* are saprobic, typically occurring on fallen, decayed, and moss-covered logs and stumps (Bera et al. 2024), and are distributed worldwide, including in Africa, Asia, Europe, North America, and South America (Bera et al. 2024).

Xeromphalina is characterised by basidiomata with a convex pileus often bearing a central depression (Miller 1968, Bera et al. 2024). The pileus surface is glabrous or pruinose, moist or dry, and ranges in colour from orangish to yellowish-brown or ochre yellow. Lamella is adnate or decurrent, intervenose, and subdistant to close. The stipe is slender, cylindrical, with a glabrous, pruinose, tomentose, or hispid surface. Basidiospores are elliptical to allantoid and amyloid. Hymenial cystidia are fusiform, subventricose, or irregularly branched. Pileocystidia are thin to thick-walled, fusoid or irregularly shaped, and hyaline to pigmented (Miller 1968, Bera et al. 2024).

Bera et al. (2024) described a new species, *X. pseudotenuipes* I. Bera & S. Khyaju, based on morphological characteristics and phylogenetic analyses (ITS, LSU, and *rpb2*). The classification of *Xeromphalina* in Species Fungorum, MycoBank and Hyde et al. (2024a) is under *Xeromphalinaceae*, whereas GenBank lists it under *Mycenaceae* and may need updating. Currently, Species Fungorum (2026) lists 36 species of *Xeromphalina*.

Synonymy: *Heimiomyces* Singer, *Omphalopsis* Earle, *Phlebomarasmius* R. Heim, *Valentinia* Velen.

Type species: *Xeromphalina campanella* (Batsch) Kühner & Maire

Basionym: *Agaricus campanella* Batsch

Other accepted species: (Species Fungorum – search *Xeromphalina*)

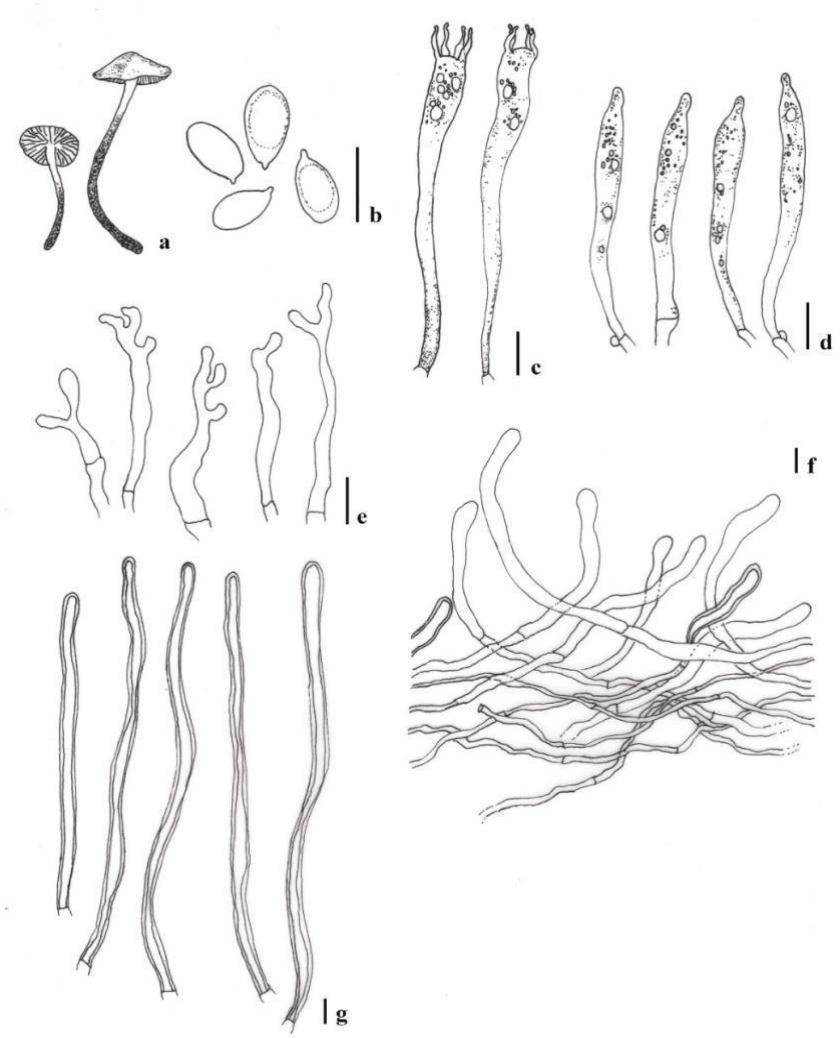


Fig. 59 – ***Xeromphalina pseudotenuipes*** (IB 23-002, holotype). a Basidiomata. b Basidiospore. c Basidia. d Basidioles. e Cheilocystidia. f Transverse section through pileipellis. g Caulocystidia. Scale bars: b–g = 10 μm. For original basidiomata, refer to Bera et al. (2024).

Marasmiineae genera incertae sedis

Lactocollybia Singer, Schweizerische Zeitschrift für Pilzkunde 17, 71

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 60

Classification: *Incertae sedis*, *Marasmiineae, Agaricales*, *Agaricomycetes*, *Agaricomycotina*, *Basidiomycota*, *Fungi*

Lactocollybia was described by Rolf Singer in 1947 (Singer 1970). The genus is characterised by its small to medium-sized mushrooms, often with a collybioid or mycenoid stature, and the presence of latex in the basidiomata (Singer 1970, Reid & Eicker 1998, Hosen et al. 2016). Species within this genus are typically found in tropical and subtropical regions, growing on decaying wood or leaf litter (Hosen et al. 2016, Hemmes & Desjardin 2022). Members of the genus *Lactocollybia* are distributed across South America, Africa, and Southeast Asia (Senthilarasu & Kumaresan 2016, Bera et al. 2025). *Lactocollybia epia* (Berk. & Broome) Pegler has been found in India, Europe, North, Central, and South America. *L. lacrimosa* (R. Heim) Singer occurs in Colombia and various regions of North America, and *L. subvariicystis* Hosen & T.H. Li in China (Catalogue of Fungi of Colombia 2025). Currently, there is no specific evidence that *Lactocollybia* species are edible,

commercially utilised, or form mutualistic associations such as ectomycorrhizae (Senthilarasu & Kumaresan 2016).

The basidiomata of *Lactocollybia* are small to medium-sized, with convex to plane caps that may become slightly depressed with age (Hosen et al. 2016). The pileus surface is often smooth, hygrophanous, and can exhibit various colours, including white, cream, or pale brown (Hosen et al. 2016, Izhar et al. 2022). The lamellae are adnate to subdecurrent, crowded, and white to pale cream (Hosen et al. 2016, Desjardin & Perry 2017). The stipe is central, cylindrical, and sometimes has a slightly bulbous base (Desjardin & Perry 2017). Microscopically, the hyphae are thin-walled, and the basidiospores are smooth, ellipsoid to oblong, and inamyloid (Hosen et al. 2016).

Phylogenetic studies have placed *Lactocollybia* within *Marasmiaceae*, closely related to *Gymnopus* (Pers.) Gray and *Marasmiellus* Murrill (Hosen et al. 2016). *Lactocollybia* is distinguished by the presence of latex (milky fluid) in its fresh basidiomes, a feature absent in *Gymnopus* and *Marasmiellus*. Molecular analyses using ITS and LSU sequences have helped clarify its taxonomic position and distinguish it from morphologically similar genera (Hosen et al. 2016). However, a further exploration of the genus is required for proper taxonomic placement. The classification of *Lactocollybia* in Species Fungorum, GenBank, UNITE, and Hyde et al. (2024a) is under *incertae sedis*, whereas MycoBank lists it under *Marasmiaceae* and may need updating.

Currently, Species Fungorum (2026) lists 19 species of *Lactocollybia*.

Synonymy: *Bertrandiella* R. Heim

Type species: *Lactocollybia lacrimosa* (R. Heim) Singer

Basionym: *Collybia lacrimosa* R. Heim

Other accepted species: (Species Fungorum – search *Lactocollybia*)

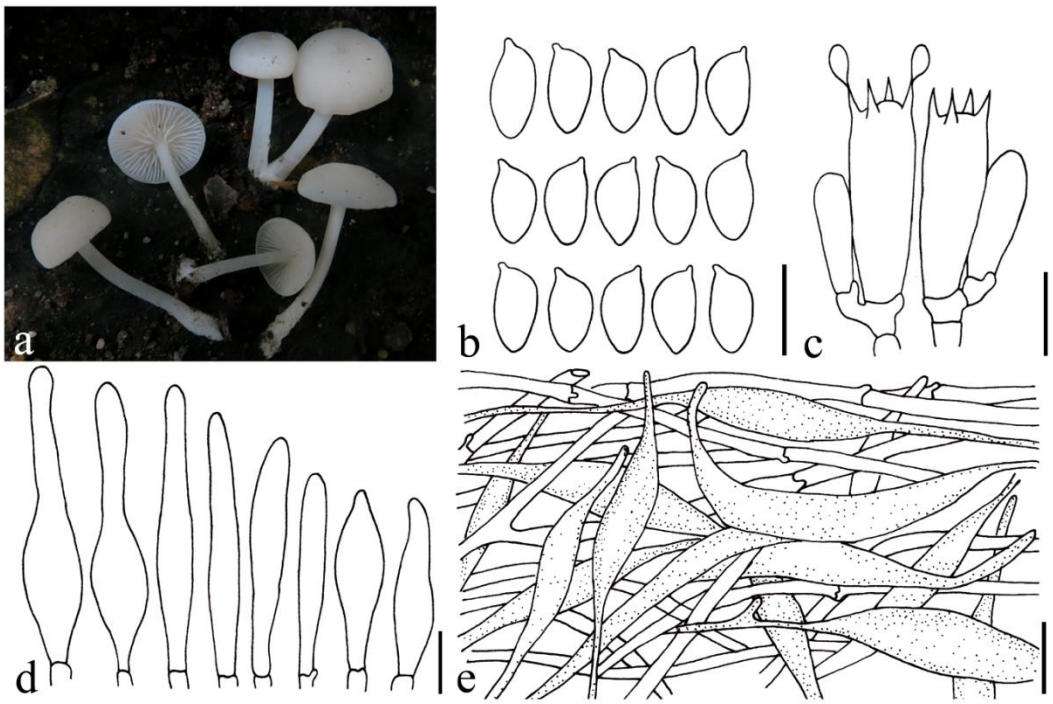


Fig. 60 – ***Lactocollybia subvariicystis*** (GDGM 46536, holotype). a Basidiomata. b Basidiospores. c Basidia and basidioles. d Cheilo- and pleurocystidia. e Pileipellis. Scale bars: b–d = 10 µm, e = 20 µm. Redrawn from Hosen et al. (2016). For original basidiomata, refer to Hosen et al. (2016).

Neoclitocybe Singer, Sydowia 15(1–6), 55

Species Fungorum, Facesoffungi, MycoBank Fig. 61

Classification: *Incertae sedis, Marasmiineae, Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Neoclitocybe was established by Rolf Singer to accommodate species exhibiting a clitocyboid to omphalioid habit, distinguished by a pileipellis with a distinct rameales-structure and smooth, inamyloid basidiospores (Singer 1962d, Sá 2016). The type species is *Neoclitocybe byssiseda* (Bres.) Singer, originally described as *Omphalia byssiseda* Bres. in *Tricholomataceae* R. Heim ex Pouzar, has currently been placed as *incertae sedis* in *Agaricales* Underw (Singer 1962d, Sá 2016, Wijayawardene et al. 2022, Putzke & Putzke 2025). These fungi are predominantly saprotrophic on decaying wood and plant remains, making them of particular interest in ecological roles in forest ecosystems (Sá 2016, Putzke & Putzke 2025). Species of the genus are distributed in tropical regions predominantly in Bolivia and Northern and Southern Brazil (Singer 1962d, 1989, Sá 2016, Putzke & Putzke 2025).

Neoclitocybe is characterised by depressed to infundibuliform basidiomata with a central to slightly eccentric stipe, an attenuated or non-attenuated base, and, more rarely, bulbous; some species have short white rhizomorphs (Singer 1962d, 1989, Putzke & Putzke 2025). Lamellae are distant and mainly deeply decurrent, white, cream, or greyish, and not identical in colour to the pileus (Singer 1962d). Basidiospores are smooth, of variable size and shape, but generally subglobose, ellipsoid, lacrimoid, oblong, or cylindrical (but not stellate), inamyloid, and acyanophilous (Singer 1962d, Sá 2016, Putzke & Putzke 2025). Basidioles are generally fusoid and basidia 2- to 4-spored, with either excessively long or usual length sterigmata (Putzke & Putzke 2025). The hyphal system is monomitic, with thin or thick walls, inamyloid, non-gelatinised hyphae, and a distinct presence of fibulae (Singer 1962d, Putzke & Putzke 2025). Pileipellar layer of the cap formed by a trichoderma or, more frequently, by diverticulated hyphae (Putzke & Putzke 2025). Currently, Species Fungorum (2026) lists 22 species of *Neoclitocybe*.

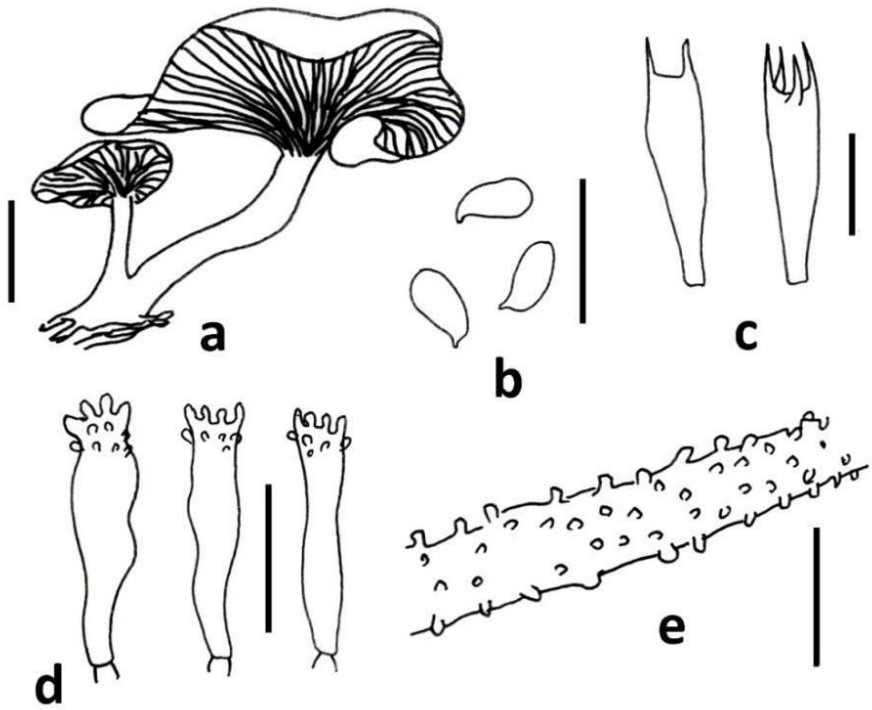


Fig. 61 – ***Neoclitocybe byssiseda*** (B2368 (LIL), holotype). a Basidiomata. b Basidiospores. c Basidia. d Cheilocystidia. e Diverticulate hyphae of the cortical layer of the pileus. Scale bars: a = 10 mm. b–e = 10 µm. Manually redrawn from Putzke & Putzke (2025). For original basidiomata, refer to Sá (2016).

Neoclitocybe has been poorly represented in large-scale phylogenetic analyses, and no study has targeted the phylogenetic analysis of the genus. Species of *Neoclitocybe* with indistinct diverticulate hyphae in the cap cortex may be mistaken for *Clitocybe* (Fr.) Staude, but they are

distinguished by the absence or reduced form of basal mycelium, shape of basidioles, and the characteristic rameales-structure with diverticulate hyphae (Sá 2016, Putzke & Putzke 2025). Species with pleurotoid basidiomata are clearly distinguished from other closely related genus *Marasmiellus* Murrill, by the presence of deeply decurrent lamellae (Putzke & Putzke 2025). In cases where basal mycelium is reduced, or inconspicuous species may also be confused with *Marasmiellus* or *Collybia* (Fr.) Staude (Putzke & Putzke 2025). Some species, including *N. byssiseda*, are edible (Boa 2004). The classification of *Neoclitocybe* in Species Fungorum and Hyde et al. (2024a) is under *incertae sedis*, whereas MycoBank and UNITE list it under *Tricholomataceae* and may need updating.

Type species: *Neoclitocybe byssiseda* (Bres.) Singer

Basionym: *Omphalia byssiseda* Bres.

Other accepted species: (Species Fungorum – search *Neoclitocybe*)

Mycenaceae Overeem, Icones Fungorum Malayensium, 14

Species Fungorum, Facesoffungi, MycoBank, GenBank

Classification: *Mycenineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Mycenaceae was established by Overeem in 1926, with *Mycena* (Pers.) Roussel as the type genus. Hyde et al. (2024a) have recognised nine genera in this family: *Cruentomycena* R.H. Petersen, Kovalenko & O.V. Morozova, *Cynema* Maas Geest. & E. Horak, *Favolaschia* (Pat.) Pat., *Flabellimycena* Redhead, *Hemimycena* Singer, *Mycena*, *Panellus* P. Karst., *Resinomycena* Redhead & Singer, and *Roridomyces* Rexer. *Mycenaceae* is characterised by lamellate basidiomata, with pale and amyloid basidiospores and dextrinoid tissues (Moncalvo et al. 2002, Wei & Kirschner 2019). Species of *Mycenaceae* are distributed worldwide and are saprotrophic on dead leaf litter and wood debris (Wei & Kirschner 2017). Notably, this family also consists of bioluminescent species, including *Filoboletus*, *Mycena*, *Panellus*, *Resinomycena*, and *Roridomyces* (Cortés-Pérez et al. 2019).

Flabellimycena Redhead, Canadian Journal of Botany 62(5), 886

Species Fungorum, Facesoffungi, MycoBank Fig. 62

Classification: *Mycenaceae, Mycenineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Flabellimycena, a monotypic genus, was established by S.A. Redhead in 1984, with its type species *F. flava* (Redhead 1984a, Hyde et al. 2024a). This species was originally described based on specimens collected from rotten wood in Colombia, South America, and was initially classified as *Pleuromycenula flava* Singer (Redhead 1984a). This genus is saprophytic and found in Colombia and Puerto Rico (Redhead 1984a, GBIF 2025). Notably, *Flabellimycena* is listed in the "List of protected generic names of fungi" under the International Code of Nomenclature for algae, fungi, and plants (Kirk et al. 2013).

Flabellimycena is characterised by small, glabrous, yellow, and slightly ciliated basidiomata (Redhead 1984a). Microscopically, its basidiospores are smooth, hyaline, and non-amyloid. Cheilocystidia are minute, irregular, and sometimes branched. The hyphae of pileipellis are non-amyloid, inflated, and clamped. The basal mycelium is waxy, composed of thick-walled, sub-gelatinised, smooth, clamped hyphae (Redhead 1984a). The hyphal system is monomitic (Redhead 1987).

Species delineation of *Flabellimycena* is based solely on macro- and micro-morphological characteristics due to the lack of molecular sequences (Miettinen & Hernawati 2010, He et al. 2019). Morphologically, *Flabellimycena* is related to *Rimbachia* Pat. and *Helotium* Tode. However, *Rimbachia* is distinguished by the absence of yellow pigment, cheilocystidia, thick-walled basal hyphae, and its habitat on a woody stem (Redhead 1984a). *Helotium* differs from *Flabellimycena* by its lack of yellow pigment. Molecular evidence is needed to differentiate *Flabellimycena* from these closely related genera. The classification of *Flabellimycena* in Species Fungorum, UNITE,

and Hyde et al. (2024a) is under *Mycenaceae*, whereas MycoBank lists it under *Tricholomataceae* and may need updating.

Type species: *Flabellimycena flava* (Singer) Redhead

Basionym: *Pleuromycenula flava* Singer

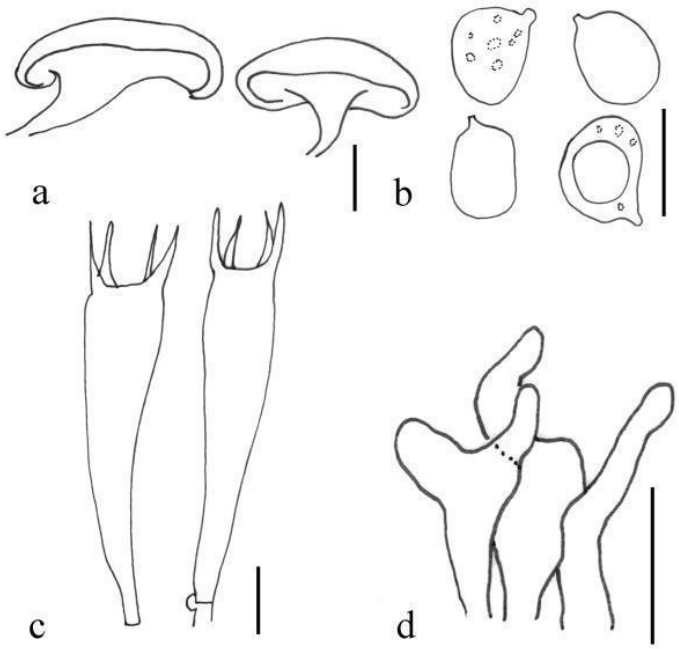


Fig. 62 – ***Flabellimycena flava***. a Basidiomata. b Basidiospores. c Basidia. d Cheilocystidia. Scale bar: a = 1 mm, b–d = 10 µm. Redrawn from: a–c = iNaturalist (2025), d = Redhead (1984a). For original basidiomata, refer to Redhead (1984a) and GBIF (2025).

Resinomycena Redhead & Singer, Mycotaxon 13(1), 151

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 63

Classification: *Mycenaceae, Mycenineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Resinomycena was established by S.A. Redhead and R. Singer in 1981, with its type species *R. rhododendri* (Redhead & Singer 1981). The type species was originally described as *Agaricus rhododendri* Peck, based on specimens collected from dead wood of *Rhododendron maximum* in New York, the USA (Peck 1875). *Resinomycena* was split from *Mycena* (Pers.) Roussel, based on abundant oleocystidia in pileus and stipe (Redhead & Singer 1981, Antonin & Noordeloos 2004). The genus is saprobic, found in leaf litter, twigs, and wood debris (Redhead & Singer 1981, Bau & Liu 2021). Members of *Resinomycena* are found in North America, Europe, Japan, Canada, Brazil, and China (Redhead & Singer 1981, Redhead 1984b, Desjardin et al. 2016, He et al. 2019).

Species of *Resinomycena* are characterised by omphaliod or mycenoid, resinous basidiomata, covered with oliecystidia intermixed with dendroid, non-diverticulate hyphae, white or dull (Redhead & Singer 1981). The lamellae are adnate to slightly decurrent, subdistant to crowded with resinous edges formed by numerous oleocystidia. The stipe is equal, cartilaginous, and resinous, covered with resinous edges formed by oleocystidia and dendrohyphidia-like cells. Basidiospores are smooth, hyaline, amyloid, and acyanophilic. Basidia are narrowly cylindrical, 4-spored, and clamped (Redhead & Singer 1981). Pileipellis has numerous dendrohyphidia-like terminal cells (Desjardin et al. 2016). Tramal tissues are weakly to strongly dextrinoid, and hyphae are intermixed. Hymenophoral trama is regular (Redhead & Singer 1981).

Bau et al. (2021) described two new species, *R. capitata* and *R. ellipsoidea*, based on morphology and phylogenetic analysis (ITS, LSU, *rpb2*, and *tef-1α*). *Resinomycena* is distinct from

its closely related genera *Baeospora* Singer, *Hydropus* Kühner ex Singer, and *Mycena* (Pers.) Roussel by the abundance of resinous oleocystidia intermixed with dendrohyphidia (Redhead & Singer 1981). Species Fungorum (2025) lists only 13 species worldwide. The classification of *Resinomycena* in *Mycenaceae, Mycenineae*, *Agaricales, Agaricomycetidae, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* is in agreement in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Type species: *Resinomycena rhododendri* (Peck) Redhead & Singer

Basionym: *Agaricus rhododendri* Peck

Other accepted species: (Species Fungorum – search *Resinomycena*)

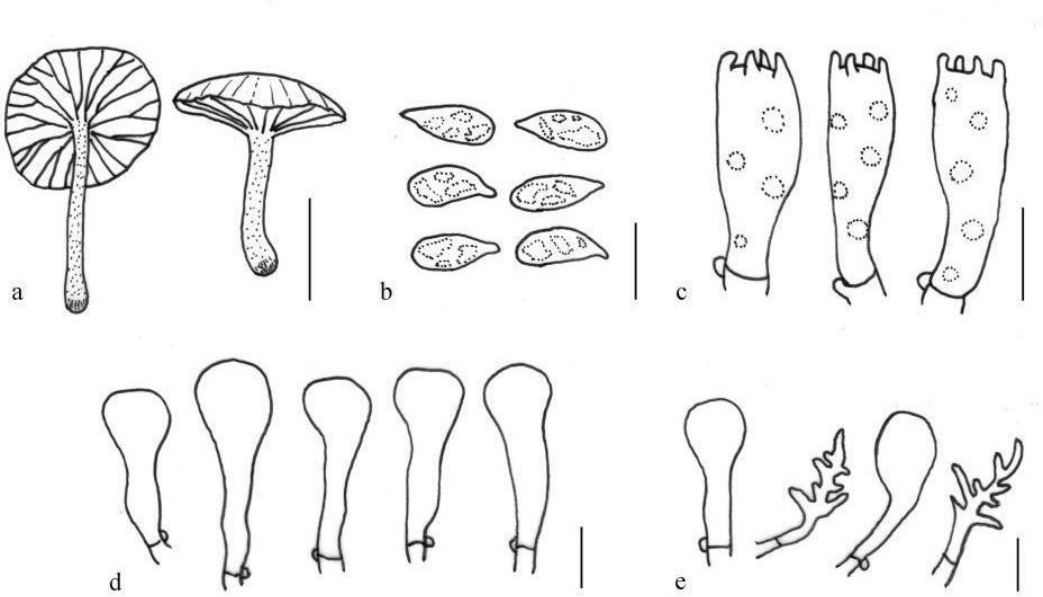


Fig. 63 – ***Resinomycena capitata***. a Basidiomata. b Basidiospores. c Basidia. d Cheilocystidia. e Caulocystidia. Scale bar: a = 5 mm, b = 5 µm, c–e = 10 µm. Redrawn from Bau et al. (2021).

Roridomyces Rexer., Die Gattung Mycena s.l., Studien zu Ihrer Anatomie, Morphologie und Systematik (Tübingen), 132

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 64

Classification: *Mycenaceae, Mycenineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Roridomyces was established by Rexer in 1994 to accommodate *R. roridus* (Fr.) Rexer (= *Mycena rorida* (Fr.) Quél.) as the type species (Rexer 1994). The species belonging to *Roridomyces* were previously placed in *Mycena* section *Roridae*, but Maas Geesteranus (1989) excluded the type species *Mycena rorida* (Fr.) Quél. from the genus *Mycena* due to the different nature of the pielipellis (hymeniform) than the other members (cutis) in the *Mycena* section *Roridae* (Karunarathna et al. 2020). The members of *Roridomyces* are known by their characteristically slimy, viscid, and glutinous stipe surface, found in moist environments (Karunarathna et al. 2020). The members of *Roridomyces* grow gregariously to cespitose, in bunches either on beds of needles or on twigs, rotting leaves, bark, and wood of trees in coniferous to broad-leaved forests such as *Pinus* sp., *Castanopsis* sp., *Leptospermum* sp., *Lithocarpus* sp., *Rhipogonum* sp., etc. *Roridomyces* shows a wide distribution, including Canada, China, Europe, Germany, India, Japan, Russia, Spain, the USA, and Vietnam (Smith 1947, Dauner et al. 2021).

Microscopically, *Roridomyces* is distinguished by a hymeniform type of pileipellis, which is composed of broadly clavate to pyriform-shaped cells (Chew et al. 2015, Cortés-Pérez et al. 2019). *Roridomyces roridus* (=*Mycena rorida*) is characterised by pileate-stipitate basidiomata, a convex pileus with a central depression at maturity, a dry surface, furfuraceous to sub-pruinose and

striatulate on the margin, greyish brown at the central disc, pale to dark brown toward margins, turning yellowish white with maturity. Lamellae are arcuate-adnate to decurrent, sub-distant, and white. Stipe is strigose at the base, covered with a thick gluten layer when young, but at maturity gets aggregated at the base, bluish black at the apex, but quickly becomes white, and brown at the base with age. Basidiospores are ellipsoidal and amyloid. Basidia are 2- or 4-spored. Cheilocystidia are abundant, fusoid, ventricose to cylindrical. Pleurocystidia are not well differentiated. Pileus trama corticated by a palisade of inflated pedicellate cells with sordid-brown contents (Smith 1947).

The well-known luminescent species in *Roridomyces* include *R. phyllostachidus* Karun., P.E. Mortimer & Axford, *R. roridus*, *R. viridiluminus* L.A.P. Dauner, A. Karun. & P.E. Mortimer (Dauner et al. 2021). Molecular studies have been conducted using ITS, LSU, and *rpb2*, suggesting *Panellus* P. Karst. as a sister group (Chew et al. 2015, Karunarathna et al. 2020, Dauner et al. 2021). However, both share the same family, pileate-stipitate basidiomata, but *Panellus* differs in its gelatinous basidiomata (vs. only stipe gelatinous in *Roridomyces*), species with two types of hymenophore (lamellate as well as poroid), thick-walled dichophysial hyphae in both trama and pileipellis (vs. thin-walled and hymeniform type pileipellis in *Roridomyces*) (Zhang et al. 2022). The species of *Roridomyces* are also described as moisture-loving fungi, and attract insects due to their luminescent properties, which aid in their spore-dispersal, thus it is assumed their co-evolution has occurred with some insects, but further studies are awaited to give clarity on this phenomenon (Cortés-Pérez et al. 2019, Karunarathna et al. 2020, Dauner et al. 2021). The classification of *Roridomyces* in *Mycenaceae, Mycenineae*, *Agaricales, Agaricomycetidae, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* is in agreement in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a). Under *Roridomyces,* Species Fungorum (2026) and Hyde et al. (2024a) list 15 species worldwide.

Synonym: *Roridella* E. Horak

Type species: *Roridomyces roridus* (Fr.) Rexer

Basionym: *Agaricus roridus* Fr.

Other accepted species: (Species Fungorum – search *Roridomyces*)

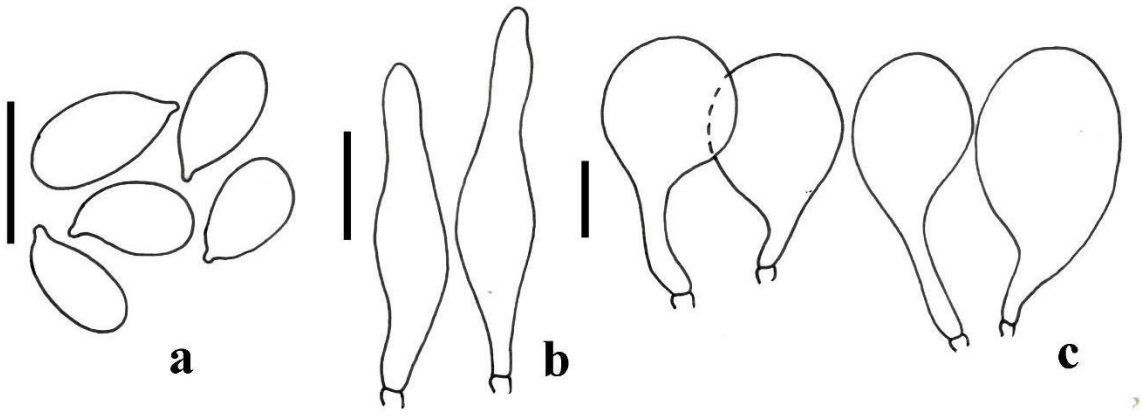


Fig. 64 – ***Roridomyces roridus***. a Basidiospores. b Cheilocystidia. c Elements of pileipellis. Scale bars: a–c = 10 µm. Redrawn from Smith (1947). For original basidiomata, refer to GBIF (2024).

Phyllotopsidineae Zhu L. Yang & G.S. Wang

Species Fungorum, Facesoffungi, MycoBank, GenBank

Pterulaceae Corner, Beihefte zur Nova Hedwigia 33, 10

Species Fungorum, Facesoffungi, MycoBank, GenBank

Classification: *Phyllotopsidineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Pterulaceae was established by E.J.H. Corner (1970) with *Pterula* Fr. as the type genus (Corner 1970). He et al. (2024) and Hyde et al. (2024a) have recognised nine genera in this family: *Allantula* Corner, *Chaetotyphula* Corner, *Coronicium* J. Erikss. & Ryvarden, *Lepidomyces* Jülich, *Merulicium* J. Erikss. & Ryvarden, *Myrmecopterula* Leal-Dutra, Dentinger & G.W. Griff., *Phaeopterula* (Henn.) Sacc. & D. Sacc., *Pterula*, and *Pterulicium* Corner. *Pterulaceae* is characterised by coralloid or filiform basidiomata with a dimitic hyphal system (Corner 1970, Leal-Dutra et al. 2018). Members of *Pterulaceae* are distributed worldwide and are mainly saprophytic, growing on wood or leaf litter; some species are pathogenic to plants, causing culm rot disease (Leal-Dutra et al. 2020).

Allantula Corner, Annals of Botany, London, n.s. 16, 270

Species Fungorum, Facesoffungi, MycoBank Fig. 65

Classification: *Pterulaceae, Phyllotopsidineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

The monotypic genus *Allantula* was established by E.J.H. Corner in 1952, with *A. diffusa* as its type species (Corner 1952a, Wijayawardene et al. 2022, Hyde et al. 2024a). The specimen was collected on dead branches in Brazil (Corner 1952a). The genus is rare, as no subsequent record has been reported (Corner 1952a, Leal-Dutra et al. 2018, 2020).

The basidiomata of *Allantula* emerge from slender rhizomorphs, which appear as small, sausage-like, decumbent swellings that are generally curved and occasionally bifid or anastomosed, with a waxy-fleshy (Corner 1952a, Leal-Dutra et al. 2018). The rhizomorph grows along the undersurface of dead wood or bark, developing numerous adventitious branches primarily in an acropetal arrangement. Lateral outgrowths of generative hyphae from the rhizomorph form basidia or cystidia. The sympodial growth of subhymenial hyphae leads to thickening of the hymenium layer (Corner 1952a).

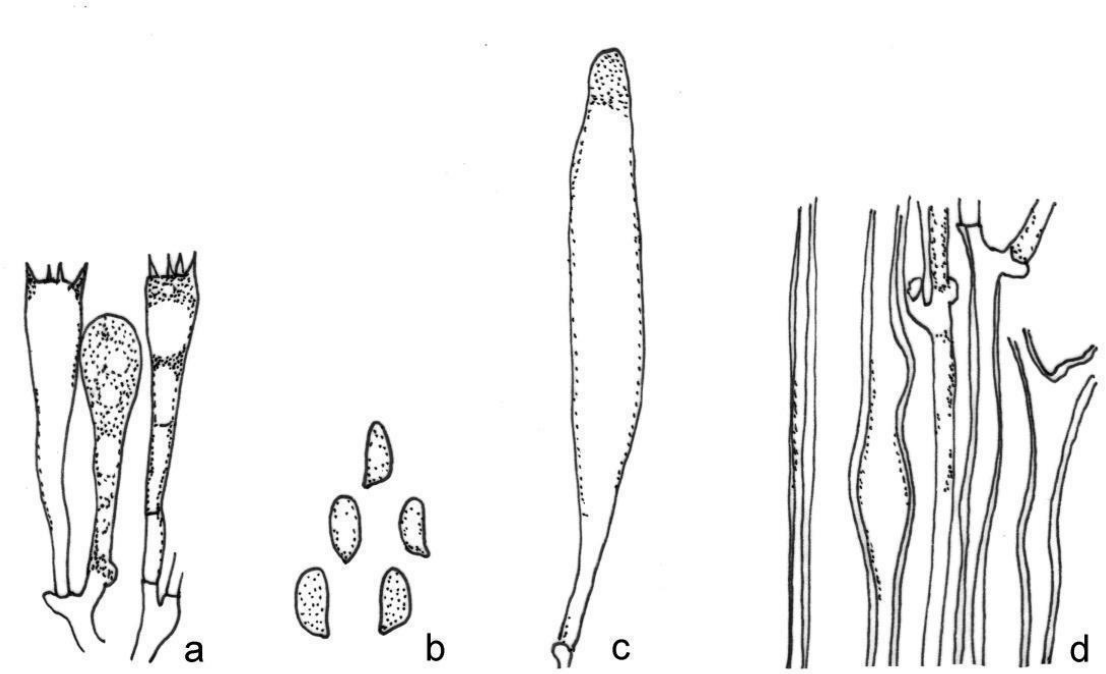


Fig. 65 – ***Allantula diffusa***. a Basidia (×1000). b Basidiospores (×1000). c Cystidia (×1000). d Hypha (×1000). Redrawn from Corner (1952).

Microscopically, the basidiospores are white, smooth, or aguttate (Corner 1952a). The basidia are four-spored. The hyphal system is dimitic, featuring clamped generative hyphae; skeletal hyphae are found only in the rhizomorphs and have hyaline, thick walls that may branch or exist as

intercalary segments of the generative hyphae. Cystidia are thin-walled and are embedded within the hymenium (Corner 1952a). Species of *Allantula* are identified solely based on the macro- and micro-morphological characteristics due to a lack of molecular evidence (Leal-Dutra et al. 2018, 2020). The classification of *Allantula* in *Pterulaceae, Phyllotopsidineae*, *Agaricales, Agaricomycetidae, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* is in agreement in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Type species: *Allantula diffusa* Corner

Chaetotyphula Corner, Monograph of *Clavaria* and allied Genera (Annals of Botany Memoirs No. 1), 207, 690

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 66

Classification: *Pterulaceae, Phyllotopsidineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Chaetotyphula was established in 1950 by E.J.H. Corner to accommodate two species, *C. actiniceps* and *C. hyaline*, which were collected from Java and Malaysia, respectively (Corner 1950). Species of *Chaetotyphula* are saprophytic (Corner 1950). The genus is globally distributed, including Argentina, Brazil, Colombia, Costa Rica, Ecuador, Panama, Puerto Rico, Singapore, and Thailand (Dentinger & McLaughlin 2006, He et al. 2019, Boonpratuang et al. 2023). Detinger & McLaughlin (2006) used morphological characteristics and phylogenetic analyses (LSU) for species delineation within *Chaetotyphula*. He et al. (2019) and Hyde et al. (2024a) have recognised seven species worldwide.

Species of *Chaetotyphula* are characterised by small basidiomata with the hymenium covering the entire head (Corner 1950, 1970, Poinar & Brown 2003). The basidiospores are broadly ellipsoid to subglobose. Basidia are typically 2-spored, occasionally 1-spored. Both leptocystidia and caulocystidia are elongated and thick-walled. The hyphal system is monomitic, characterised by thin-walled generative hyphae (Corner 1950, 1970, Poinar & Brown 2003).

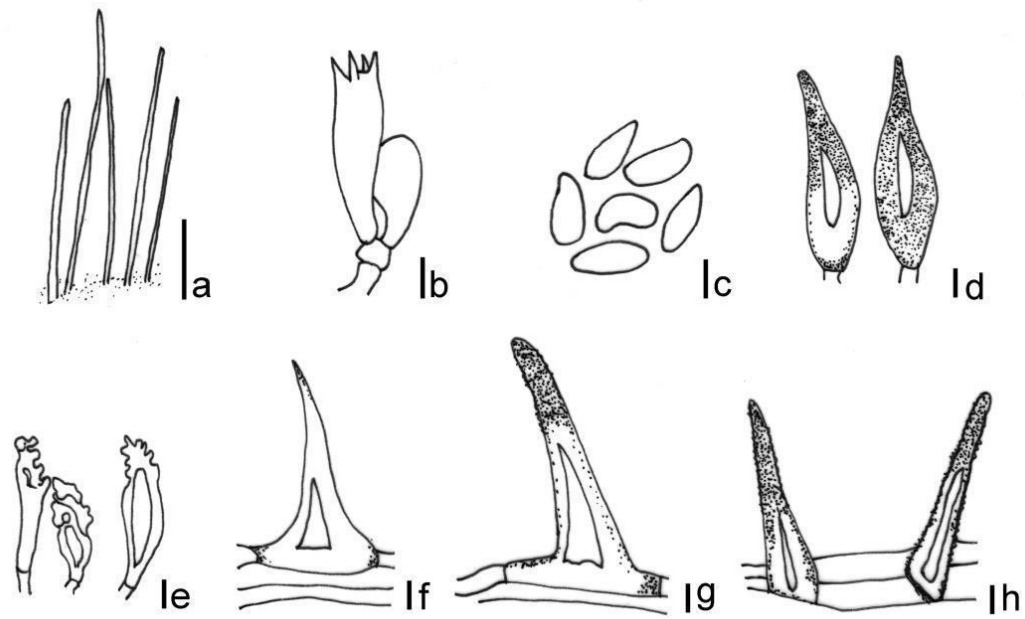


Fig. 66 – ***Chaetotyphula columbiana*** (a = BBH24935, b–h = BBH01684). a Basidiomata. b Basidia. c Basidiospores. d Head-metuloid cystidia. e Thick- and thin-walled head diverticulate. f Cystidia without metuloid. g Triangular cystidia with metuloid. h Traingular caulocystidia with metuloid at stipe. Scale bar: a = 5 mm, b–h = 10 µm. Redrawn from Boonpratuang et al. (2023).

Chaetotyphula, along with *Pistillaria* Fr. and *Typhula* (Pers.) Fr., is classified within typhyloid fungi of the *Agaricales* (Corner 1967). However, *Chaetotyphula* is distinguished from *Typhyla* in the absence of sclerotia, the lack of non-thickening hyphae, and the presence of thick-walled cystidia (Boonpratuang et al. 2023). *Chaetotyphula* and *Pistillaria* are taxonomically closer due to the absence of sclerotium in their basidiomata (Boonpratuang et al. 2023). However, *Pistillaria* lacks cystidia (Corner 1950, 1953, Boonpratuang et al. 2023). Additionally, *Chaetotyphula* is morphologically similar to *Actiniceps* Berk. & Broome in terms of small size, lack of pigmentation, the presence of hymenial and/or caulocystidia, hyaline appearance, and smooth-walled, globose to ellipsoid basidiospores (Dentinger & McLaughlin 2006, Boonpratuang et al. 2023). The classification of *Chaetotyphula* in Species Fungorum, GenBank, UNITE, and Hyde et al. (2024a) is under *Pterulaceae*, whereas MycoBank lists it under *Gomphaceae* and may need updating.

Type species: *Chaetotyphula hyalina* (Jungh.) Corner

Basionym: *Typhula hyaline* Jungh.

Other accepted species:

C. actiniceps (Petch) Corner
C. amylochaete Singer
C. columbiana Singer
C. gelatinosa Corner
C. montana Singer
C. tetraspora Corner

Parapterulicium Corner, Annals of Botany, London, n.s. 16, 285

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 67

Classification: *Pterulaceae, Phyllotopsidineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Parapterulicium, a genus of coralloid fungi, was established by E.J.H. Corner in 1952 (Corner 1952a). The type species, *P. subarbusculum*, was described from a collection of dead twigs and leaves in Brazilian forests (Corner 1952a). In the same publication, Corner also described another *P. octopodites* Corner. However, in 2018, this species was reclassified as *Baltazaria octopodites* (Corner) Leal-Dutra, Dentinger & G.W. Griff. (Leal-Dutra et al. 2018). Corner (1957) also described *P. simplex*, based on specimens collected from Argentina. Within *Parapterulicium*, Species Fungorum (2026) lists two species, worldwide. *Parapterulicium* species are saprophytic in Argentina and Brazil (Corner 1952a, 1957).

Parapterulicium is characterised by its basidiomata, which occur solitary or in small groups (Corner 1952a). The stipe is glabrous or subfibrillose, sterile, becoming pale brownish, and is attached to substrates by a small floccose mycelial disc. The branches are slender at the base and tapered into filiform points. The resupinate corticoid patch of the basidiomata on hosts appears dry, floccoso-coriaceous, and light-coloured. Gleocystidia are clavate to cylindrical, blunt, thin-walled, and extend through the thickened hymenium. Discophyses are hyaline, slender, and abundant, with short, tapering arms emerging from the subhymenial generative hyphae. The hyphal system is dimitic, consisting of clampless generative hyphae, while the ends of skeletal hyphae either dichophyses or appear papillate in the hymenium (Corner 1952a).

Species delineation of *Parapterulicium* from other genera is based on morphological characteristics and phylogenetic analyses (ITS and LSU) (Leal-Dutra et al. 2018). Morphologically, *Parapterulicium* is closely related to *Pterula* Fr., particularly in its adventitious branching (Corner 1952a). However, the latter is distinguished by its hard and horny basidiomata upon drying. Additionally, *Parapterulicium* resembles *Pterulicium* Corner due to its corticioid state. Nevertheless, both *Pterula* and *Pterulicium* differ from *Parapterulicium* by their lack of gloecystidia (Corner 1952a). The classification of *Parapterulicium* in Species Fungorum, GenBank, UNITE, and Hyde et al. (2024a) is under *Pterulaceae*, whereas MycoBank lists it under *Peniophoraceae* and may need updating.

Type species: *Parapterulicium subarbusculum* Corner
Other accepted species:
P. simplex Corner

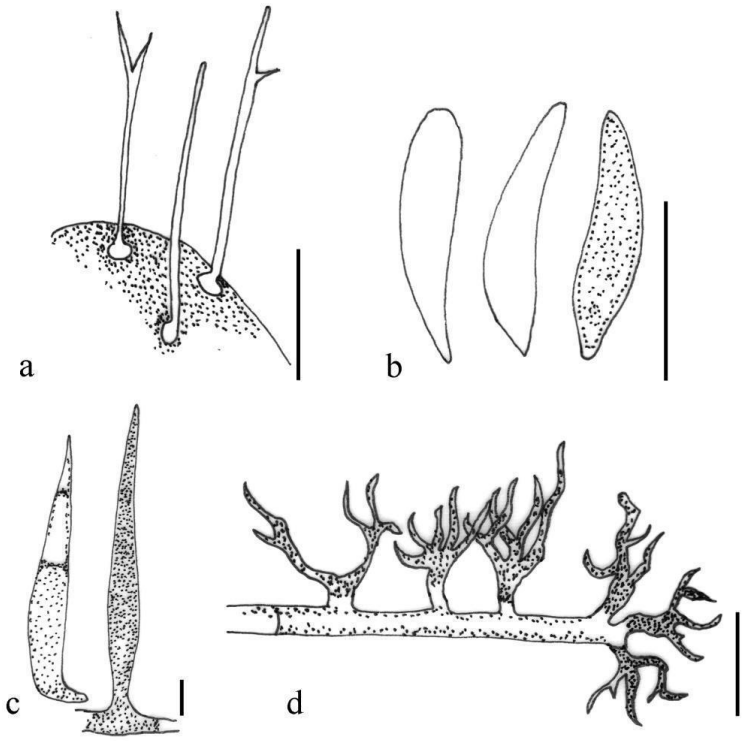


Fig. 67 – ***Parapterulicium subarbusculum***. a Basidiomata. b Basidiospores. c Gloeocystidia. d Dichophyses. Scale bar: a = 1 cm, b–d = 10 µm. Redrawn from Leal-Dutra et al. (2018). For original basidiomata, refer to Leal-Dutra et al. (2018).

Pterulicium Corner, Monograph of *Clavaria* and allied Genera (Annals of Botany Memoirs No. 1), 689, 699

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 68

Classification: *Pterulaceae, Phyllotopsidineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota*, *Fungi*

Pterulicium was established by E.J.H. Corner in 1950, with the type species *P. xylogenum* (Corner 1952b). Most *Pterulicium* species inhibit soil or litter, whereas *P. xylogenum* is known to cause culm rot disease in bamboo (Harsh et al. 2005, Leal-Dutra et al. 2020).

The basidiomata of *Pterulicium* are typically pteruloid, rarely corticioid, appearing solitary or gregarious, and are simple or scarcely branched, with occasional significant unilateral branching (Leal-Dutra et al. 2020). The stipe can range in colour from creamy white to brown, with tips that are creamy white or pale brown on uniformly coloured basidiomata. The hyphal system is dimitic, consisting of slightly thick-walled skeletal hyphae and thin-walled, often clamped generative hyphae. Hymenial cystidia are usually present, while caulocystidia are only sometimes observed. Basidia are terminal and vary in shape from clavate to suburniform. Basidiospores can be globose, subglobose, pip-shaped, amygdaliform to subamygdaliform, or ellipsoid (Leal-Dutra et al. 2020).

Pterulicium differs from the closely related genus *Phaeopterula* Henn. by having pigmentation only at the stipe base and mostly unbranched basidiomata. In contrast, *Phaeopterula* has a distinct brown main axis and symmetrical branching (Leal-Dutra et al. 2020). Leal-Dutra et al (2020) used both morphological and phylogenetic analyses of combined ITS, LSU, and *rpb2* to identify species within *Pterulicium,* which verified 31 species from *Pterula* Fr. and 15 from *Deflexula* Corner to *Pterulicium* (Olariaga et al. 2022). The classification of *Pterulicium* in

Pterulaceae, Phyllotopsidineae, *Agaricales, Agaricomycetidae, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* is in agreement in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a). Species Fungorum (2026) lists approximately 42 species within *Pterulicium.*

Synonymy: *Deflexula* Corner

Type species: *Pterulicium xylogenum* (Berk. & Broome) Corner

Basionym: *Clavaria xylogena* Berk. & Broome

Other accepted species: (Species Fungorum – search *Pterulicium*)

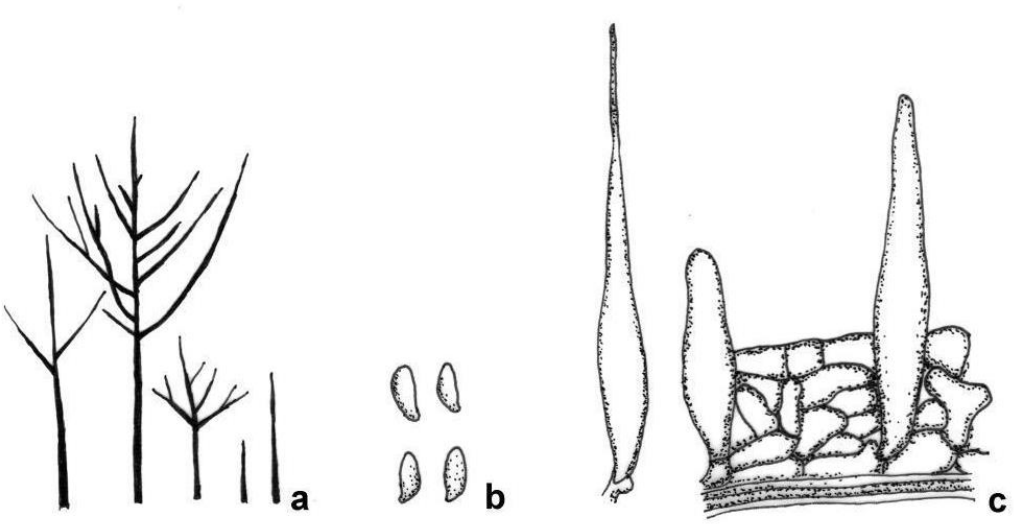


Fig. 68 – ***Pterulicium fluminense*** (holotype). a Basidiomata (×2). b Basidiospores (×1000). c Caulocystidia (×1000). Redrawn from Corner (1952).

Pleurotineae Aime, Dentinger & Gaya

Species Fungorum, Facesoffungi, MycoBank, GenBank

Cyphellopsidaceae Jülich, Bibliotheca Mycologica 85, 362

Species Fungorum, Facesoffungi, MycoBank

Classification: *Pleurotineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Agaricomycetes also comprises fungi that form highly reduced basidiomata, commonly referred to as cyphelloid fungi, and early classifications grouped these reduced forms into the artificial family *Cyphellaceae* Burnett (Burnett 1835, Donk 1966, Agerer 1979). Later, fungi with reduced morphologies were adjusted in *Porotheleaceae* Murrill; however, molecular phylogenetic studies have demonstrated that cyphelloid fungi constitute a polyphyletic assemblage, with multiple independent lineages distributed across the order *Agaricales* (Moncalvo et al. 2002, Matheny et al. 2006, Moreno et al. 2017). Jülich (1982) established *Niaceae* Jülich to accommodate the genus *Nia* R.T. Moore & Meyers, typified by the marine species *Nia vibrissa* R.T. Moore & Meyers and classified many genera in *Cyphellopsidaceae* Jülich, typified by *Cyphellopsis anomala* (Pers.) Donk. At present, the families *Cyphellopsidaceae* Jülich and *Niaceae* Jülich are considered to be associated with the so-called Nia clade, which corresponds to *Cyphellopsidaceae* in a broad sense (Bodensteiner et al. 2004). The name *Cyphellopsidaceae* has been formally selected over *Niaceae,* although *Niaceae* is still retained in usage by some authors (Knudsen & Vesterholt 2012, Kalichman et al. 2020). Currently, *Cyphellopsidaceae* includes 14 genera: *Akenomyces* G. Arnaud ex D. Hornby, *Calathella* D.A. Reid, *Dendrothele* Höhn. & Litsch., *Digitatispora* Doguet, *Eoscyphella* Silva-Filho, Stevani & Menolli, *Flagelloscypha* Donk, *Halocyphina* Kohlm. & E.

Kohlm., *Lachnella* Fr., *Merismodes* Earle, *Nia*, *Peyronelina* P.J. Fisher, J. Webster & D.F. Kane, *Phaeodepas* D.A. Reid, *Pseudolasiobolus* Agerer, and *Woldmaria* W.B. Cooke (Hyde et al. 2024a).

Halocyphina Kohlm. & E. Kohlm., Nova Hedwigia 9, 100

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 69

Classification: *Cyphellopsidaceae, Pleurotineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Halocyphina is a monotypic genus established by J. Kohlmeyer & E. Kohlmeyer in 1965, with its type species *H. villosa* (Kohlmeyer 1965, Hyde et al. 2024a). This species was originally described from specimens collected on rotten driftwood in the sea in Florida, USA (Kohlmeyer 1965). Later, Ginns & Malloch (1977) re-described this genus. *Halocyphina* occurs as a saprobe in coastal marine environments, particularly on the roots and wood of mangroves (Hyde 1989). It is distributed in Andaman and Nicobar Islands, Brunei, India, Indonesia, Malaysia, Seychelles, Thailand, and the USA (Alias & Jones 2000, Venkateswara Sarma et al. 2001, Prasannarai & Sridhar 2003, Fryar et al. 2004).The classification of *Halocyphina* in Hyde et al. (2024a) is under *Cyphellopsidaceae*, whereas Species Fungorum and GenBank list it under *Niaceae* and may need updating.

Halocyphina is characterised by cyphelloid basidiomata, which are initially globose with a short stipe and later develop into a funnel-shaped form with a saucer-like hymenium that is pale yellow or pale orange-yellow (Ginns & Malloch 1977). The external surface of the basidiomata is covered with numerous scattered hairs that are wavy, hyaline, refractive, and not incrusted. The context comprises closely packed hyphae oriented more or less parallel to the hymenium. Microscopically, the basidiospores are subglobose, hyaline, smooth, indextrinoid, and inamyloid. Basidia are short, broad, clavate or cylindrical, with a narrow base and 2–4 sterigmata. The hyphae are hyaline, thin-walled, occasionally branched, and exhibit rare clamp connections (Ginns & Malloch 1977).

Halocyphina shares similarities with *Henningsomyces* Kuntze and *Rectipilus* Agerer, but is distinguished from both by its marine habitat and the presence of a covered hymenium at maturity. Additionally, it differs from the latter genera by having hyaline and unincrusted hairs (Ginns & Malloch 1977).

Type species: *Halocyphina villosa* Kohlm. & E. Kohlm.

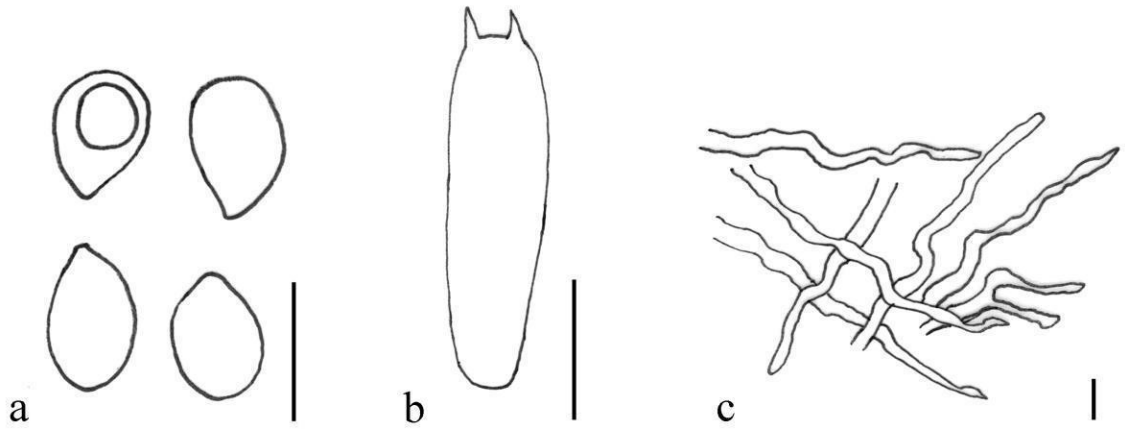


Fig. 69 – ***Halocyphina villosa***. a Basidiospores. b Basidium. c Exterior hairs on basidiomata. Scale bar: a–c = 10 µm. Redrawn from Ginns & Malloch (1977). For original basidiomata, refer to Ginns & Malloch (1977).

Merismodes Earle, Bulletin of the New York Botanical Garden 5, 406

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 70

Classification: *Cyphellopsidaceae, Pleurotineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Merismodes was established by F.S. Earle (1909) with *M. fasciculata* as the type species, described initially as *Cantharellus fasciculatus* from bark in New York, USA (Earle 1909). Members of *Merismodes* are saprobic and widely distributed (Silva-Filho et al. 2023, He et al. 2019). Within *Merismodes*, Species Fungorum (2026) lists 12 species worldwide. The classification of *Merismodes* in Hyde et al. (2024a) is under *Cyphellopsidaceae*, whereas Species Fungorum, MycoBank, GenBank, and UNITE list it under *Niaceae* and may need updating.

Members of *Merismodes* are characterised by minuscule basidiomata, gregarious, and growing in clusters (Adamcik 2001). The receptacles are cyphelloid, cupulate or tubular, pendant or sessile, with a smooth hymenium and a covering of yellow-brown to brown hairs (Adamcik 2001, Silva-Filho et al. 2023). The subiculum is either developed or absent (Silva-Filho et al. 2023). The external hyphae are thick-walled, straight, unbranched, yellow to brown pigmented, terminal ends incrusted or smooth, obtuse to inflated, and inamyloid (Adamcik 2001, Silva-Filho et al. 2023). The trama can be gelatinous or non-gelatinous (Silva-Filho et al. 2023). Basidiospores are ellipsoid, subglobose, cylindrical, allantoid, or subfusiform, smooth, hyaline, thin-walled, and inamyloid. Basidia are cylindrical to clavate, typically 4-spored, but occasionally 2-spored, and cystidia are absent or rarely present. Clamp connection either present or absent (Silva-Filho et al. 2023).

The taxonomic placement of *Merismodes* has been revised several times. Initially, Donk (1951) classified it in *Cyphellaceae* Burnett, later transferred to *Cyphellopsidaceae* Jülich (Jülich 1982), then to *Crepidotaceae* (S. Imai) Singer (Moser 1983), and most recently to *Niaceae* Jülich (Silva-Filho et al. 2023). Molecular phylogenetic analyses (ITS and LSU) confirmed *Merismodes* as a monophyletic lineage. Silva-Filho et al. (2023) reported three new combinations: *M. monacha* (Speg.) Silva-Filho, Mombert & Menolli, *M. filipendula* (Læssøe) Silva-Filho & Menolli, and *M. subsphaerospora* (Mombert) Silva-Filho, Mombert & Menolli.

Synonymy: *Cyphellopsis* Donk, *Maireina* W.B. Cooke, *Phaeocyphellopsis* W.B. Cooke, *Pseudodasyscypha* Velen.

Type species: *Merismodes fasciculata* (Schwein.) Donk

Basionym: *Cantharellus fasciculatus* Schwein.

Other accepted species: (Species Fungorum – search *Merismodes*)

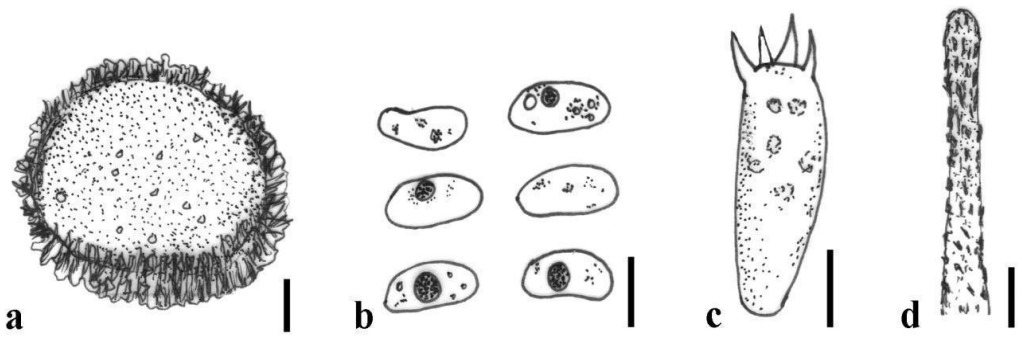


Fig. 70 – ***Merismodes monacha*** (ALV30536). a Basidiomata. b Basidiospores. c Basidia. d External hyphae. Scale bar: a = 0.5 mm, b–d = 10 µm. Redrawn from Silva-Filho et al. (2023). For original basidiomata, refer to Silva-Filho et al. (2023).

Woldmaria W.B. Cooke, Beihefte zur Sydowia 4, 29

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 71

Classification: *Cyphellopsidaceae, Pleurotineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Woldmaria is a monotypic genus established by W.B. Cooke in 1961 in honour of the Swedish mycologist S. Woldmar (Cooke 1961, Piatek & Bujakiewicz 2004, Hyde et al. 2024a).

Initially, the genus was classified in *Cyphellopsidaceae* Jülich (Cooke 1961) but later reclassified under *Niacea* Jülich (Jülich 1981). The type species, *W. crocea*, was initially described as *Solenia crocea* P. Karst., based on a specimen collected on a dead frond (rhachis) of *Struthiopteris germanica* in Finland (Cooke 1961). *Woldmaria crocea* was synonymised with *W. filicina* (Knudsen & Hansen 1996). This genus is saprobic and host-specific on dead parts of ferns, primarily in *Matteucia struthiopteris* (Dam & Dam-Elings 1991, Piatek & Bujakiewicz 2004). It is distributed across Europe and North America, including Austria, Canada, Denmark, Finland, Germany, Norway, Poland, Romania, Sweden, the Czech Republic, and the USA (Knudsen & Hansen 1996, Piatek & Bujakiewicz 2004, Bresinsky 2018). The classification of *Woldmaria* in Hyde et al. (2024a) is under *Cyphellopsidaceae*, whereas Species Fungorum, GenBank and UNITE list it under *Niaceae* and may need updating.

Woldmaria is characterised by its annual, minute, and densely gregarious basidiomata, cylindrically elongated, sessile, and inrolled margins, brown, smooth, and covered with yellow-brown hairs on the surface, while the hymenial surface is brown. The marginal hairs are thick-walled, cylindrical, acuminate, smooth, and septate with a yellow-brown base and hyaline tip. Microscopically, basidiospores are fusiform, apiculate, smooth, and hyaline, containing a central oil drop. Basidia are clavate, four-spored, and clamped at the base. The hyphal system is monomitic, consisting of thin-walled, branched, and clamped hyphae (Piatek & Bujakiewicz 2004).

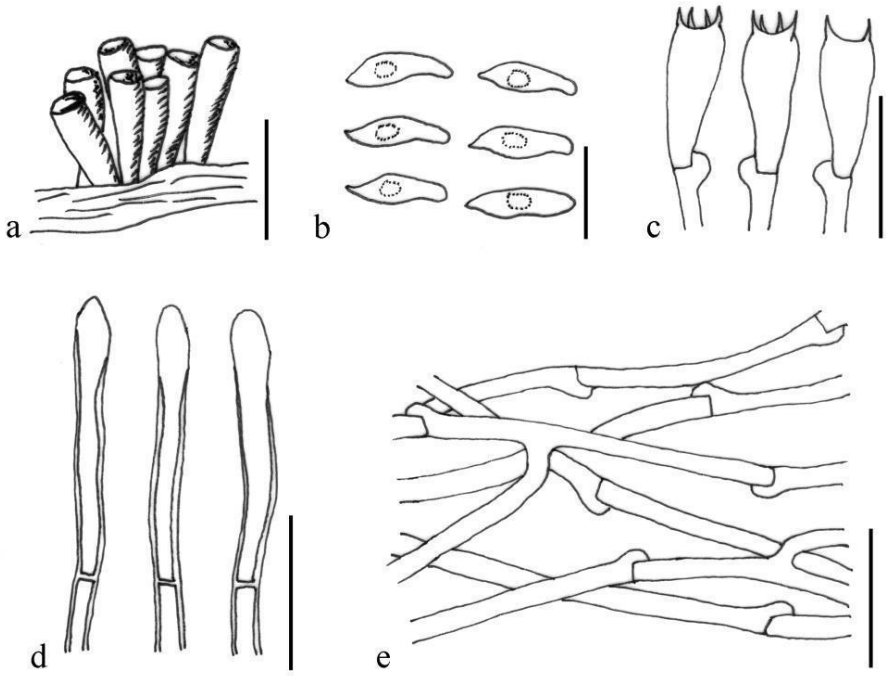


Fig. 71 – ***Woldmaria filicina*** (KRAM F-51212). a Basidiomata. b Basidiospores. c Basidia. d Marginal hairs. e Hyphae. Scale bar: a = 2 mm, b = 10 µm, c–e = 30 µm. Redrawn from Piatek & Bujakiewicz (2004). For original basidiomata, refer to GBIF (2025).

Bodensteiner et al. (2004) utilised morphological characteristics and phylogenetic analysis (ITS) to delineate *Woldmaria* from other genera. Recently, Silva-Filho et al. (2023) found that *Woldmaria* forms a sister clade to *Eoscyphella* Silva-Filho, Stevani & Menolli based on molecular analysis using the LSU dataset. *Woldmaria* is also morphologically similar to *Eoscyphella*; however, the former is distinct from the latter by the absence of conspicuous long hairs in the receptacle, its subglobose to broadly ellipsoid basidiospores, regularly bi-spored basidia, and unclamped hyphae (Silva-Filho et al. 2023).

Type species: *Woldmaria filicina* (Peck) Knudsen

Basionym: *Solenia filicina* Peck

Pleurotaceae Kühner, Bulletin Mensuel de la Société Linnéenne de Lyon 49, 184

Species Fungorum, Facesoffungi, MycoBank, GenBank

Classification: *Pleurotineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Pleurotaceae was established by R. Kühner in 1980 with *Pleurotus* (Fr.) P. Kumm. as the type genus (Kühner 1980). Hyde et al. (2024a) reported five genera in this family: *Agaricochaete* Eichelb., *Hohenbuehelia* Schulzer, *Lignomyces* R.H. Petersen & Zmitr., *Pleurotus*, and *Radulomycetopsis* Dhingra, Priyanka & J. Kaur. Members of *Pleurotaceae* are distributed worldwide and are saprotrophic (He et al. 2019). Some species, including *Pleurotus ostreatus* (Jacq.) P. Kumm., are highly edible and have potential nutraceutical and biotechnological applications (Niego et al. 2021).

Agaricochaete Eichelb., Verhandlungen des Naturwissenschaftlichen Vereins in Hamburg, Serie 3, 14, 58

Species Fungorum, Facesoffungi, MycoBank Fig. 72

Classification: *Pleurotaceae, Pleurotineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Agaricochaete was established by F. Eichelbaum in 1906 to accommodate two new species, *A. mirabilis* and *A. hericium*, which were collected from the East Usambara Mountains in Tanzania (Eichelbaum 1906, Natarajan & Raman 1980). *Agaricochaete* is a rare fungus (Pegler 1977, Natarajan & Raman 1980). Pegler (1977) described *A. keniensis* as a new species from Kenya, and in 1980, Natarajan & Raman described *A. indica* from India (Pegler 1977, Natarajan & Raman 1980). Within *Agaricochaete*, Species Fungorum (2026) lists four species worldwide.

Species of *Agaricochaete* are characterised by clitocyboid basidiomata with a depressed to infundibuliform and subhygrophanous pileus (Pegler 1977). The lamellae are decurrent, moderately spaced, with lamellulae, and the edge of the lamellae is heteromorphic. The stipe is well-developed, tubular and hollow, central, concolourous to the pileus, and has no veil. Basidiospores are hyaline, cylindrical, thin-walled, and smooth, while basidia are narrowly clavate and produce four basidiospores. The hyphal system is monomitic with clamp connections but non-gelatinised. Cheilocystidia are present, and pleurocystidia are thick-walled, pointed, and encrusted metuloids (Pegler 1977).

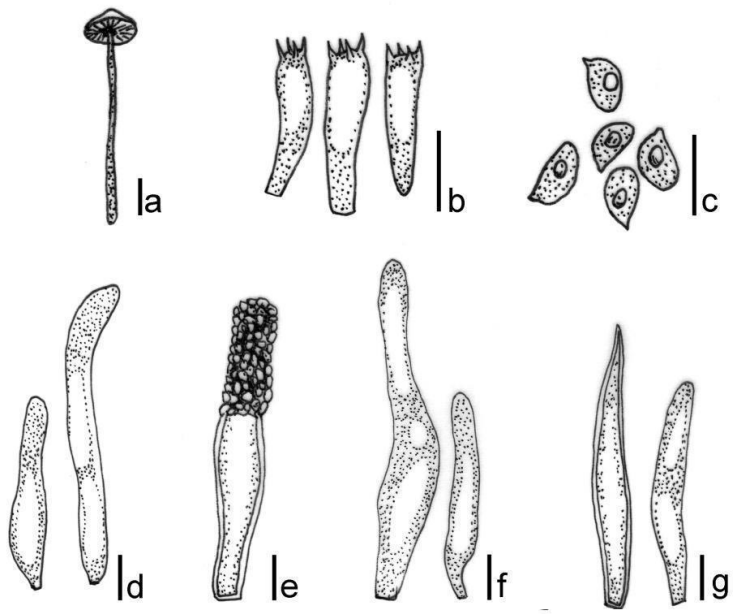


Fig. 72 – ***Agaricochaete indica***. a. Basidiomata. b Basidia. c Basidiospores. d Cheilocystidia. e Pleurocystidia. f Caulocystidia. g Pileocystidia. Scale bar: a = 1 cm, b–g = 10 µm. Redrawn from Natarajan & Raman (1980).

Identification of *Agaricochaete* species is based entirely on macro- and micro-morphological characteristics due to a lack of molecular evidence (He et al. 2019). *Agaricochaete* species are similar to *Hymenochaete* Lév. and *Hydnochaete* Bres. in terms of hymenium morphology; however, *Agaricochaete* is distinct in having thick lamellae (Eichelbaum 1906). The classification of *Agaricochaete* in *Pleurotaceae, Pleurotineae*, *Agaricales, Agaricomycetidae, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* is in agreement in Species Fungorum, MycoBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Type species: *Agaricochaete mirabilis* Eichelb.

Other accepted species:

A. hericium Eichelb.

A. indica Natarajan & Raman

A. keniensis Pegler

Tricholomatineae Aime, Dentinger & Gaya

Species Fungorum, Facesoffungi, MycoBank, GenBank

Biannulariaceae Jülich, Bibliotheca Mycologica 85, 356

Species Fungorum, Facesoffungi, MycoBank, GenBank

Classification: *Tricholomatineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Biannulariaceae was established by Jülich (1981) placed in the suborder *Tricholomatineae* Aime, Dentinger & Gaya (Hyde et al. 2024a). Members of *Biannulariaceae* are characterised by tricholomatoid, collybioid, or pleurotoid basidiomata, with adnate or decurrent lamellae, a white spore print, and smooth hyaline basidiospores. The lamella-edges are with or without cheilocystidia, the hymenium lacks true pleurocystidia, and pseudocystidia are rare. Lamellar trama is regular or bilateral, and the pileipellis is a cutis, ixocutis, or trichoderm-type. Hyphae are with or without clamp (Ammirati et al. 2007, Sánchez-García et al. 2016, Raj et al. 2019). The family includes three genera: *Bonomyces* Vizzini, *Catathelasma* Lovejoy, and *Cleistocybe* Ammirati, A.D. Parker & Matheny (Hyde et al. 2024a). Members of *Biannulariaceae* are distributed in both tropical and temperate regions and are either saprotrophic or ectomycorrhizal (Sánchez García et al. 2016, Raj et al. 2019). The genera *Catathelasma* Lovejoy are considered edible (Ammirati et al. 2007).

Catathelasma Lovejoy, Botanical Gazette 50(3), 383

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 73

Classification: *Biannulariaceae, Tricholomatineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Catathelasma was established by Ruth Harrison Lovejoy, with *C. evanescens* as the type species (Lovejoy 1910, Ge et al. 2020). Species of *Catathelasma* are ectomycorrhizal (Trappe 1962, Tedersoo & Smith 2013, Ge et al. 2020). The type specimen was collected from open balsam and spruce woods, occurring singly in sod on thick humus in Wyoming, USA (Lovejoy 1910). Global Biodiversity Information Facility (2024) indicates the distribution of species of *Catathelasma* in the Northern Hemisphere. The basidiomata are characterised by distinct tricholomatoid morphology, featuring decurrent to adnate to sinuate-adnexed lamellae, a double annulus, bilateral to subregular lamella trama, and a firm, white context (Lovejoy 1910, Ge et al. 2020). The pileus is somewhat fleshy, initially convex, and then expands (Lovejoy 1910, Ge et al. 2020). Basidiospores are white, oblong, smooth, amyloid, and acyanophilic (Ge et al. 2020). Clamp connections are present (Ge et al. 2020).

Catathelasma species were delineated using morphological characters, phylogenetic evidence (ITS, LSU, and *tef1-1α*), host preferences, and biogeographical distribution (Ge et al. 2020). Ge et al. (2020) revealed the presence of two monophyletic clades within *Catathelasma*, namely the imperiale clade and the subalpinum clade. *Catathelasma* forms a sister clade with *Cleistocybe*

Ammirati, A.D. Parker & Matheny (Ammirati et al. 2007). However, *Cleistocybe* has not been reported as ectomycorrhizal and is characterised by inamyloid basidiospores and a partial veil (Ammirati et al. 2007). Hyde et al. (2024a) and Species Fungorum (2026) have recognised six species worldwide within *Catathelasma*. The edible mushroom, *Catathelasma ventricosum,* is reported to possess antidiabetic, antihyperglycemic, antihyperlipidemic, antibacterial, and antioxidant activities (Liu et al. 2013, 2016, 2017a). The classification of *Catathelasma* in *Biannulariaceae, Tricholomatineae*, *Agaricales, Agaricomycetidae, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* is in agreement in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Synonymy: *Biannularia* Beck

Type species: *Catathelasma evanescens* Lovejoy

Other accepted species:

C. imperiale (P. Karst.) Singer

C. laorentou Z.W. Ge

C. singeri Mitchel & A.H. Sm.

C. subalpinum Z.W. Ge

C. ventricosum (Peck) Singer

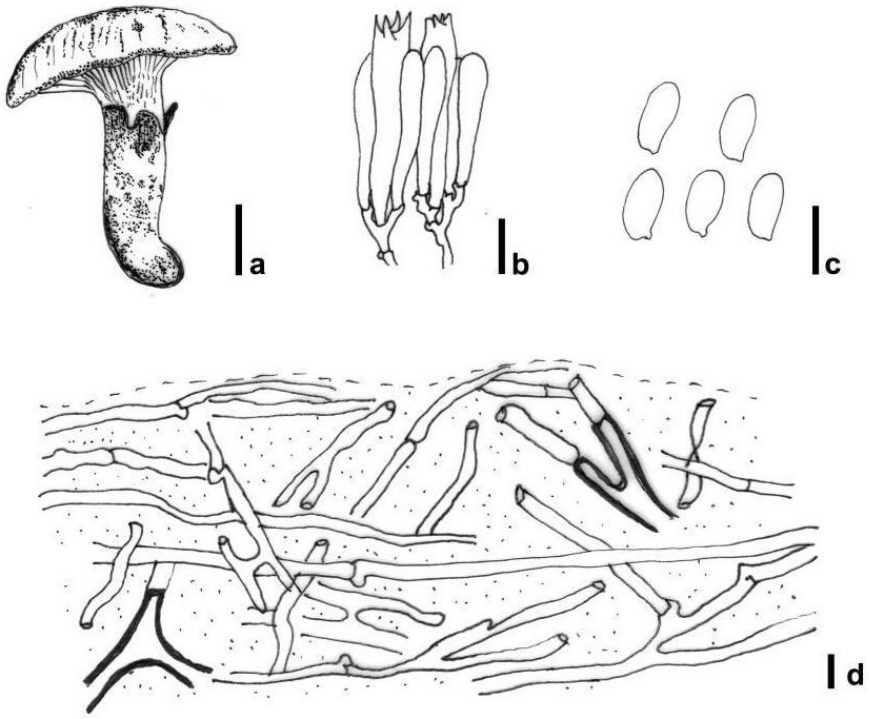


Fig. 73 – ***Catathelasma laorentou*** (a = HKAS 92245, b–d = HKAS 105984). a Basidiomata. b Basidia. c Basidiospores. d Pileipellis, oleiferous hyphae are indicated by thick-walled hyphae. Scale bar: a = 2.5 cm, b–d = 10 μm. Redrawn from Ge et al. (2020).

Callistosporiaceae Vizzini, Consiglio, M. Marchetti & P. Alvarado, Fungal Diversity 101, 223

Species Fungorum, Facesoffungi, MycoBank, GenBank

Classification: *Tricholomatineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Callistosporiaceae was established by A. Vizzini, G. Consiglio, M. Marchetti, & P. Alvarado in 2020, with *Callistosporium* Singer as the type genus (Vizzini et al. 2020a). The genera included in this family are *Anupama* K.N.A. Raj, K.P.D. Latha & Manim., *Callistosporium* Singer,

Guyanagarika Sánchez-García, T.W. Henkel & Aime, *Macrocybe* Pegler & Lodge, *Pseudolaccaria* Vizzini, Contu & Z.W. Ge, and *Xerophorus* (Bon) Vizzini, Consiglio & M. Marchetti (Hyde et al. 2024a). Members of the genera of *Callistosporiaceae* have tricholomatoid, collybioid, or plerotoid basidiomata, with adnate to adnexed, or emarginated-adnexed lamellae, regular to subregular hymenophoral trama, inamyloid basidiospores, and a lack of partial veil (Vizzini et al. 2020a). Members of *Callistosporiaceae* exhibit either saprotrophic or ectomycorrhizal, and are found on soil or rotten wood (Vizzini et al. 2020a).

Callistosporium Singer, Mycologia 36(4), 363

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 74

Classification: *Callistosporiaceae, Tricholomatineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Callistosporium was established by Singer in 1944, with *C. palmarum* as the type species (Singer 1986). The genus had undergone several taxonomic revisions, initially being placed in *Tricholomataceae* R. Heim ex Pouzar (Kaygusuz & Şengül 2021, Moncalvo et al. 2002). More recently, it was reclassified under *Entolomataceae* Kotl. & Pouzar based on rRNA data (Matheny et al. 2006, Kaygusuz & Şengül 2021). Sánchez-García et al. (2016) used phylogenetic inference to place the genus in *Catathelasmataceae* Wasser. Recently, Vizzini et al. (2020a) reclassified it under *Callistosporiaceae*. *Callistosporium* are saprobic, growing on humus, litter, and wood debris, and are distributed worldwide (Singer 1986, He et al. 2019, Vizzini et al. 2020a, Kaygusuz & Şengül 2021).

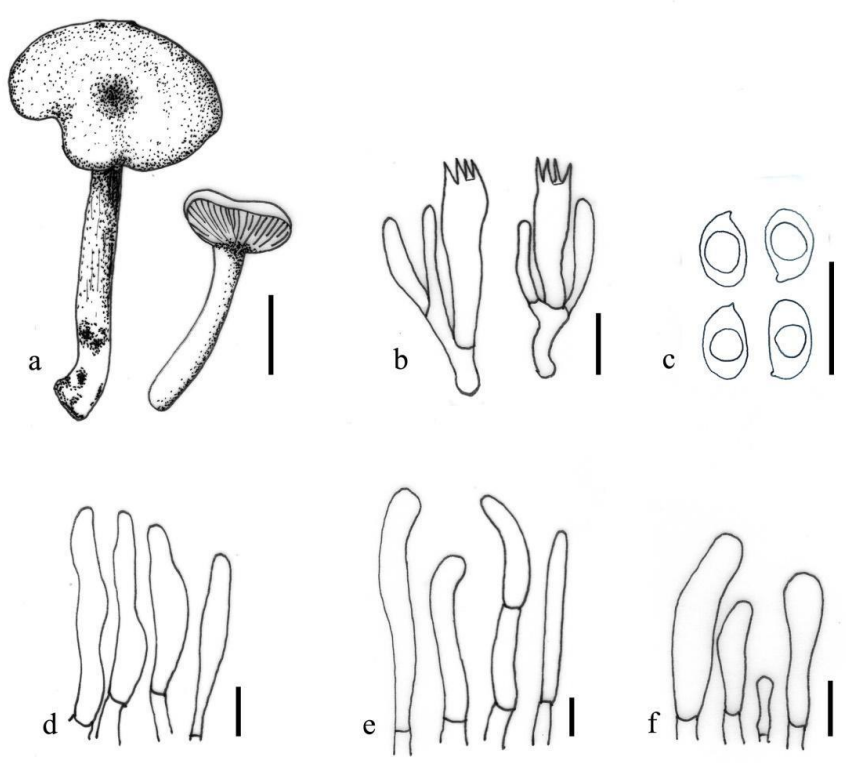


Fig. 74 – ***Callistosporium luteo-olivaceum***. a Basidiomata. b Basidia and hymenial elements. c Basidiospores. d Cheilocystidia. e Pileipellis elements. f Caulocystidia. Scale bar: a = 1 cm, b−f = 10 µm. Redrawn from Kaygusuz & Şengül (2021).

The basidiomata of *Callistosporium* species exhibit a collybioid habit (Kaygusuz & Şengül 2021). The pileus is convex to applanate, with subdecurrent, adnexed, or emarginated lamellae, and the central stipe is either eccentric or lateral (Vizzini et al. 2020a, Kaygusuz & Şengül 2021).

Lamellae are usually crowded, adnate, adnexed, or emarginated-adnexed (Vizzini et al. 2020a). Basidiospores are ellipsoid, smooth, inamyloid, indextrinoid, cyanophilous, and white in deposit (Singer 1986, Arnolds 2006, Halama & Rutkowski 2014, Jančovičová et al. 2016, Kaygusuz & Şengül 2021). Cheilocystidia, pleurocystidia, and clamp connections may or may not be present (Kaygusuz & Şengül 2021). The pileipellis and stipitipellis contain encrusted and intracellular pigmented hyphae. The context exhibits lilac, violet, and olive-yellow staining in the KOH reaction (Kaygusuz & Şengül 2021). Hyphae are clampless (Jančovičová et al. 2016).

Species delineation within *Callistosporium* is based on combined morphological and phylogenetic analyses (ITS and LSU) (Kaygusuz & Şengül 2021). Within *Callistosporium,* Species Fungorum (2026) lists 23 species worldwide. The classification of *Callistosporium* in *Callistosporiaceae, Tricholomatineae*, *Agaricales, Agaricomycetidae, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* agrees in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Synonymy: *Pleurocollybia* Singer

Type species: *Callistosporium palmarum* (Murrill) Singer

Basionym: *Gymnopus palmarum* Murrill

Other accepted species: (Species Fungorum – search *Callistosporium*)

Clitocybaceae Vizzini, Consiglio & M. Marchetti, Species Fungorum 462, 1

Species Fungorum, Facesoffungi, MycoBank, GenBank

Classification: *Tricholomatineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Clitocybaceae, initially referred to as "Clitocybées", was later validly published and typified by *Clitocybe* (Fr.) Staude (Roze 1876, Vizzini et al. 2020b). This family consists of seven genera: *Clitocybe*, *Collybia* (Fr.) Staude, *Dendrocollybia* R.H. Petersen & Redhead, *Lepista* (Fr.) W.G. Sm., *Lepistella* T.J. Baroni & Ovrebo, *Pseudolyophyllum* Raithelh., and *Singerocybe* Harmaja (Hyde et al. 2024a). Members of the family are characterised by clitocyboid, collybioid, or lepistoid basidiomata, absence of veil, adnexed to decurrent lamellae, hyaline, smooth to warty, and verrucose inamyloid basidiospores, and absence of pleurocystidia (Vizzini et al. 2020b, 2024). Species of this family are saprotrophic or mycosaprobic and found mainly on soil and litter, some on dead wood or other fungi (Vizzini et al. 2024).

Lepistella T.J. Baroni & Ovrebo, in Ovrebo & Baroni, Fungal Diversity 27(1), 159

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 75

Classification: *Clitocybaceae, Tricholomatineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Lepistella was introduced and classified as a small lignicolous agaric genus with pale pinkish buff spore deposits and characteristic gymnocarpic development under *Tricholomataceae* R. Heim ex Pouzar (Ovrebo & Baroni 2007). The presence of a pale pink to pinkish buff spore print and inamyloid, cyanophilic, verrucose basidiospores shows similarity with *Lepista* (Fr.) W. G. Sm. However, the lignicolous habit and the presence of gelatinised tissues in the context strongly distinguish it from *Lepista*. *Lepistella* is easily identified in the field by its small size, brown, broadly depressed, smooth pileus with a dark brown disc, closely spaced adnate or subdecurrent lamellae, a central to eccentric stipe, and its tendency to grow in dense clusters on fallen, decaying dicotyledonous logs or stumps. Microscopically, small strongly verrucose basidiospores which turn dark yellow when mounted in 10% NH_4OH or 3% KOH, and the striking presence of corrugated-collapsed is a characteristic of the genus. Additionally, the presence of obscurely gelatinising hyphae, which appear to have collapsed like the folds in an accordion, makes up most of the lamella trama and pileus context (Ovrebo & Baroni 2007).

Lepistella is a monotypic genus with *L. ocula*, which was initially classified under *Tricholomataceae* R. Heim ex Pouzar (Ovrebo & Baroni 2007). Vizzini et al. (2024) conducted a revisionary study in systematic arrangement within the family *Clitocybaceae* and order *Agaricales*.

He et al. (2023) conducted a separate phylogenetic analysis based on LSU data; however, the study did not resolve the taxonomic position of the genus due to a lack of sufficient molecular sequences. The classification of *Lepistella* in Hyde et al. (2024a) is under *Clitocybaceae*, whereas Species Fungorum and UNITE list it under *incertae sedis* and may need updating.

Type species: *Lepistella ocula* T.J. Baroni & Ovrebo

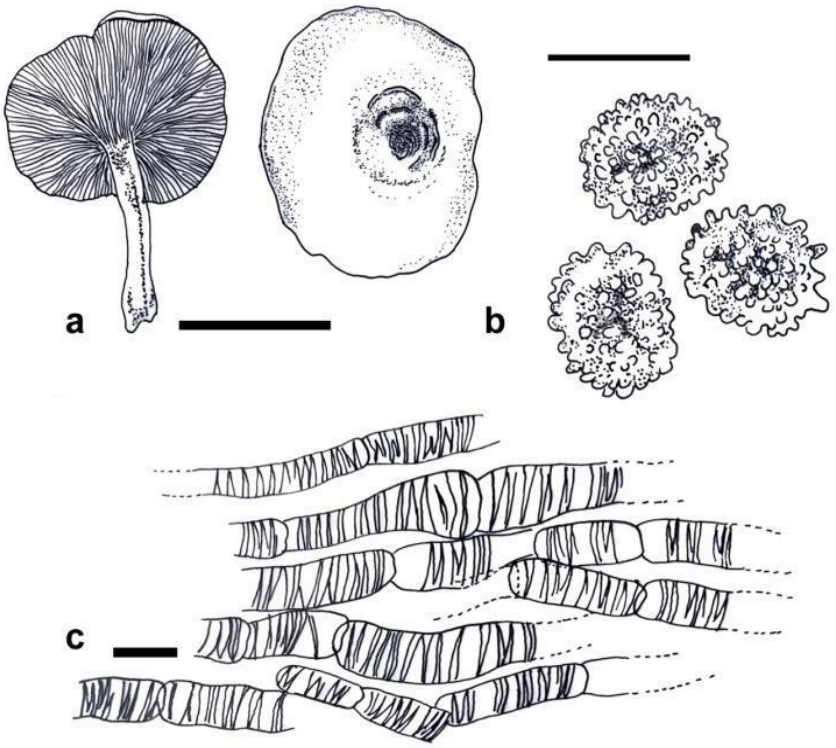


Fig. 75 – ***Lepistella ocula***. a Basidiomata. b Basidiospores drawn from SEM images. c Gelatinised hyphae of pileus context. Scale bars: a = 1 cm, b = 5 µm, c = 10 µm. Redrawn from Ovrebo & Baroni (2007) or see researchgate.

Fayodiaceae Jülich, Bibliotheca Mycologica 85, 367

Species Fungorum, Facesoffungi, MycoBank

Classification: *Tricholomatineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Fayodiaceae was established by Jülich in 1982, typified with *Fayodia* Kühner (Vizzini et al. 2024). Members of the family are characterised by omphalinoid basidiomata, with regular hymenophoral trama, thin-walled hymenial cystidia, hyaline, globose or ellipsoid, thin-walled, smooth, amyloid, and a complex wall structure of a spiny endosporium overlain by a smooth episporium (Vizzini et al. 2024). This family consists of five genera: *Caulorhiza* Lennox, *Conchomyces* Overeem, *Fayodia*, *Gamundia* Raithelh., and *Myxomphalia* Hora (He et al. 2024, Hyde et al. 2024a).

Conchomyces Overeem, in Heyne, De Nuttige Planten van Nederlandsch-Indië, Editie 2, Deel 1, 78

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 76

Classification: *Fayodiaceae, Tricholomatineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Conchomyces was established by Casper van Overeem in 1927, with its type species, *C. verrucisporus* (Heyne 1927). The type species was described based on specimens collected from

rotten wood in Java, Indonesia (Heyne 1927). In 1981, Horak reclassified *Agaricus bursiformis* Berk. as *C. bursiformis* (Berk.) E. Horak, with the species collected from bark in Tasmania, Australia (Hooker 1860, Horak 1981). Species of *Conchomyces* are saprophytic and distributed across Australasia and southern South America, including New Zealand, New Caledonia, Papua New Guinea, and Chile (Horak 1981). The classification of this genus has undergone several revisions (Henrici 2003). Notably, Reid (1963) transferred *Agaricus bursiformis* to *Hohenbuehelia* Schulzer due to its gelatinous pileus layer and metuloidal pleurocystidia. In 1969, Singer established a new subgenus, *Reidia*, within *Hohenbuehelia,* to accommodate this species, along with his collection from Chile (Horak 1981). It was also synonymised with *Crepidotus* (Fr.) Staude (Henrici 2003). However, this genus was revived after the new combination, *Conchomyces bursiformis,* was recognised (Horak 1981, Henrici 2003). Phylogenetic analyses (LSU) further supported *Conchomyces* as a distinct genus, separate from others (Moncalvo et al. 2002). Within *Conchomyces*, Species Fungorum lists two species worldwide. The classification of *Conchomyces* in MycoBank, GenBank, and Hyde et al. (2024a) is under *Fayodiaceae*, whereas Species Fungorum and UNITE list it under *incertae sedis* and *Biannulariaceae*, respectively and may need updating.

Species of *Conchomyces* are characterised by a polymorphic shape, starting convex when immature and becoming conchate or fan-shaped upon maturity (Horak 1981). Stipe is absent, rudimentary or cylindrical in an eccentric position, and concolourous with the pileus. Basidiospores are ellipsoid to broadly ovate to subglobose and spinulose, and produce a white spore print. Basidia are 4-spored and possess basal clamp connections. Chielocystidia are vesiculose, clavate, or uteriform, hyaline, and have thin-walled membranes. Pleurocystidia are fusoid, with the apex either pointed or rounded. Hyphae exhibit clamp connections (Horak 1981). Both taste and odour are negligible (Petersen & Mccleneghan 1995). *Conchomyces* shares macro-morphological similarities with *Hohenbuehelia*, *Pleurotopsis* (Henn.) Earle and *Resupinatus* Nees ex Gray (Horak 1981, Peterson & McCleneghan 1995). However, they differ by having smooth basidiospores (Horak 1981).

Type species: *Conchomyces verrucisporus* Overeem

Other accepted species: *C. bursiformis* (Berk.) E. Horak

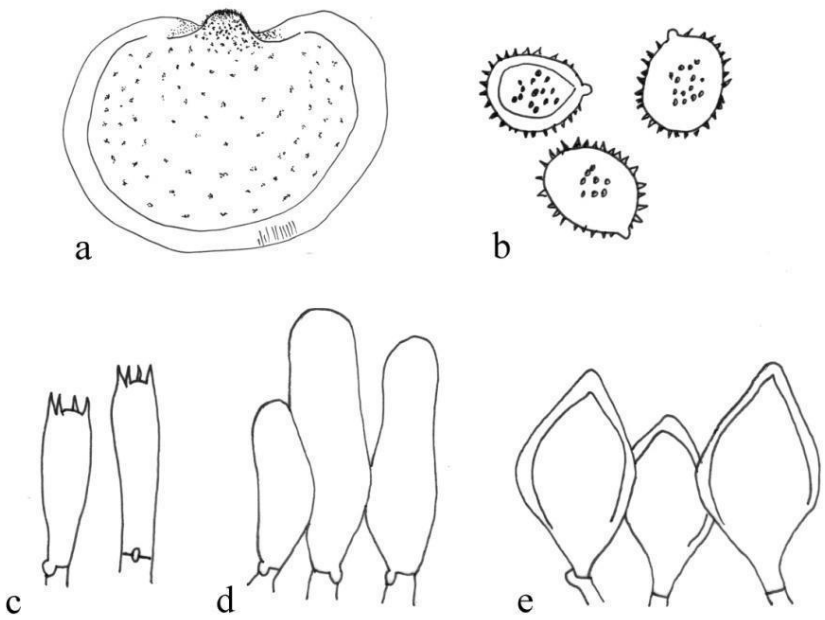


Fig. 76 – ***Conchomyces bursiformis*** (ZT 72/260). a Basidiomata. b Basidiospores. c Basidia. d Cheilocystidia. e Pleurocystidia. Redrawn from Horak (1981). For original basidiomata, refer to GBIF (2025).

Fayodia Kühner, Bulletin de la Société Linnéenne de Lyon 9, 68

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 77

Classification: *Fayodiaceae, Tricholomatineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Fayodia is a small genus originally defined within *Tricholomataceae*; however, it is currently placed as *incertae sedis* within the order *Agaricales* (Wijayawardene et al. 2022). The type species is *F. gracilipes* (Britzelm.) Bresinsky & Stangl (Blanco-Dios 2021). Species of *Fayodia* predominantly occur in lignicolous or terrestrial habitats (Pegler 1983a, Blanco-Dios 2021). Members of *Fayodia* are cosmopolitan in distribution, with most species concentrated in temperate regions, especially the Northern Hemisphere (Europe, temperate North America, and parts of temperate Asia). (Pegler 1983a, Antonin 1999, 2004, Blanco-Dios 2021).

Basidiomata of *Fayodia* are omphalinoid, mycenoid, or collybioid with a pileus ranging in colour from brown and dark greyish brown to white, and a glabrous surface (Bigelow 1979). The lamellae are adnate to decurrent, typically whitish to greyish. The stipe is central and flexuous, and the context is inamyloid, with or without clamp connections (Bigelow 1979, Blanco-Dios 2021). The hymenophoral trama is regular with 2- or 4-spored basidia having a fertile lamellar edge. Cheilocystidia and pleurocystidia are either present or absent (Bigelow 1979). The pileipellis forms an epicutis or ixocutis composed of repent or semierect hyphae (Bigelow 1979, Blanco-Dios 2021). The basidiospores are globose, subglobose, ellipsoid, oblong, or cylindrical, hyaline, and possess a two-layered wall structure; an inner amyloid or pseudoamyloid, ornamented (echinulate to verruculose) layer overlain by a smooth perisporial layer (Bigelow 1979, Antonin 2004, Blanco-Dios 2021). The pileipellis and stipitipellis are dry and non-gelatinised (Antonin 2004).

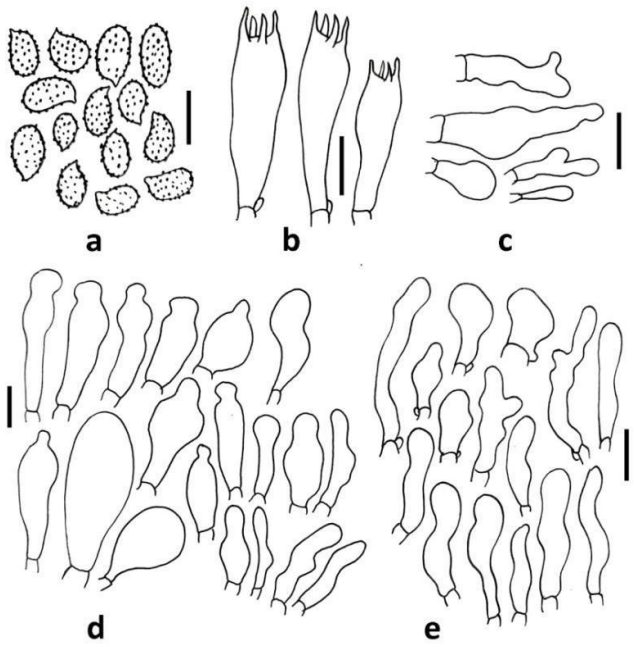


Fig. 77 – ***Fayodia gallaecicoloniana*** (LOU-Fungi 21051, holotype). a Basidiospores. b Basidia. c Cheilocystidia. d Pleurocystidia. e Caulocystidia. Scale bar: a–e = 10 µm. Manually redrawn from Blanco-Dios (2021). For original basidiomata, refer to Blanco-Dios (2021).

The classification of *Fayodia* in MycoBank, GenBank, and Hyde et al. (2024a) is under *Fayodiaceae*, whereas Species Fungorum and UNITE list it under *incertae sedis* and may need updating. Currently, *Fayodia* consists of 13 recognised species worldwide (Hyde et al. 2024a).

Fayodia is closely related to *Gamundia* Raithelh; however, the latter is distinct by thin-walled, verruculose to echinulate, non-amyloid basidiospores and a gelatinised pileipellis (Antonin

2004). Additionally, species of *Fayodia* have also been confused with the closely related genus *Collybia* (Fr.) Staude because of similar small to medium-sized collybioid basidiomata; however, the latter lacks the amyloid or pseudoamyloid ornamented spore wall (Pegler 1983a).

Type species: *Fayodia gracilipes* (Britzelm.) Bresinsky & Stangl

Basionym: *Agaricus gracilipes* Britzelm.

Other accepted species: (Species Fungorum – search *Fayodia*)

Tricholomataceae R. Heim ex Pouzar, Česká Mykologie 37(3), 175

Species Fungorum, Facesoffungi, MycoBank, GenBank

Classification: *Tricholomatineae*, *Agaricales*, *Agaricomycetes*, *Agaricomycotina*, *Basidiomycota*, *Fungi*

Tricholomataceae was established by Z. Pouzar (1983) with *Tricholoma* (Fr.) Staude as the type genus (Pouzar 1983). He et al. (2024) and Hyde et al. (2024a) have recognised ten genera in this family: *Albomagister* Sánchez-García, Birkebak & Matheny, *Corneriella* Sánchez-García, *Dennisiomyces* Singer, *Dermoloma* J.E. Lange ex Herink, *Leucopaxillus* Boursier, *Porpoloma* Singer, *Pseudobaeospora* Singer, *Pseudoporpoloma* Vizzini & Consiglio, *Pseudotricholoma* (Singer) Sánchez-García & Matheny, and *Tricholoma*. *Tricholomataceae* is characterised by tricholomatoid basidiomata, with conical, convex, plano-convex to applanate, smooth, tomentose, scaly, or viscid pileus and adnate, adnexed, sinuate-emerginate to decurrent lamellae (Sánchez-García et al. 2014). Basidiospores are subglobose, ellipsoid or ellipsoid-oblong, thin-walled, hyaline, smooth or verrucose, amyloid or inamyloid, without a germ pore, while the spore print is pure white. Members of *Tricholomataceae* are distributed worldwide, mainly in north and south temperate regions, and can be either mycorrhizal or saprotrophic (Sánchez-García et al. 2014).

Dennisiomyces Singer, Anais da Sociedade de Biologia de Pernambuco 13(1), 225

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 78

Classification: *Tricholomataceae*, *Tricholomatineae*, *Agaricales*, *Agaricomycetes*, *Agaricomycotina*, *Basidiomycota*, *Fungi*

Dennisiomyces was erected by Rolf Singer in 1955, with *D. glabrescentipes* Singer as the type species (Singer 1956). *Dennisiomyces* species are mainly found in tropical and subtropical regions (Sánchez-García et al. 2014, Corriol & Jargeat 2019). The habit of *Dennisiomyces* is tricholomatoid and often found growing in humus-rich warm, humid environments (Singer 1956).

Dennisiomyces is characterised by smooth, ellipsoid, amyloid spores, along with the presence of cheilocystidia and numerous, well-differentiated pleurocystidia (Sánchez-García et al. 2014). It also features hyphae of the carpophore with clamp connections and erect to suberect terminal cells of the pileipellis (Sánchez-García et al. 2014). The terminal cells of the superficial hyphae are either ascendant or erect-depressed, resembling the numerous cheilocystidia that contribute to the heteromorphous edge of the lamellae. Broader and conspicuous cystidia are abundant on the sides of the lamellae, distinguishing these species. The lamellae are sinuate, with a distinct wavy edge, characteristic of this genus. The context is fleshy, indicating a soft and thick texture when cut or handled. *Dennisiomyces* is not lignicolous and has a brown to fuscous pigmentation. The hymenophoral trama is inamyloid; therefore, it does not stain blue or black when treated with iodine solutions like Melzer's reagent. The genus was described based on distinctive features of its epicuticular hyphae and cystidia. The terminal cells of the superficial hyphae are either ascendant or erect-depressed, resembling the numerous cheilocystidia that contribute to the heteromorphous edge of the lamellae. Broader and conspicuous cystidia are abundant on the sides of the lamellae, distinguishing these species. Two notable species, *D. glabrescentipes* and *D. griseus*, exhibit tricholomatoid habits, with the former likely terrigenous and the latter growing on humus. Both species have hyphae with clamp connections and smooth, amyloid, ellipsoid spores (Singer 1956).

Although *Dennisiomyces* species are not closely related to any known agaric genera, comparisons have been made with amyloid-spored members of *Tricholomataceae* R. Heim ex Pouzar, such as *Porpoloma* Singer, *Hydropus* Kühner ex Singer, and *Heimiomyces* Singer.

However, *Dennisiomyces* differs in several aspects, including the presence of pleurocystidia and the structure of the epicutis. Unlike *Porpoloma*, which lacks pleurocystidia, *Dennisiomyces* shows no significant similarity in habitat or geographic distribution. Thus, *Dennisiomyces* remains distinct, characterised by its characteristic amyloid spores, pleurocystidia, and unique habitat preferences (Singer 1956). ITS, LSU, SSU, and *rpb2* gene regions have been used for phylogenetic analysis of *Dennisiomyces* (Sánchez-García et al. 2014, Corriol & Jargeat 2019). The classification of *Dennisiomyces* in *Tricholomataceae*, *Tricholomatineae*, *Agaricales*, *Agaricomycetidae, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* agrees in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Within *Dennisiomyces,* Species Fungorum (2026) lists 6 species worldwide.

Type species: *Dennisiomyces glabrescentipes* Singer

Other accepted species:

D. fibrillosus G. Corriol & P. Jargeat
D. fuscoalbus Singer
D. griseus (Dennis) Singer
D. lanzonii Robich
D. rionegrensis Singer

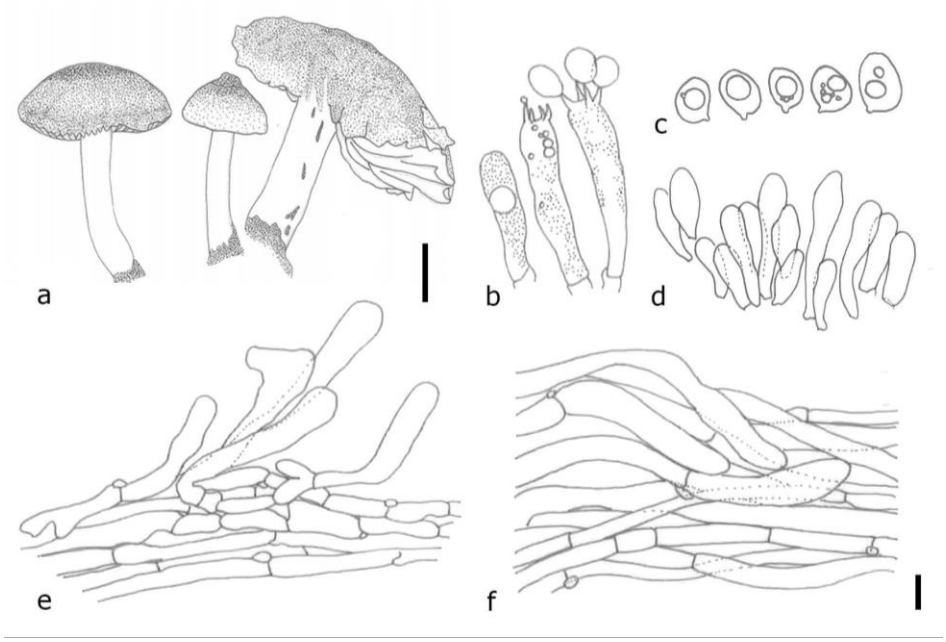


Fig. 78 – ***Dennisiomyces fibrilosus***. a Basidiomata. b Basidia and Basidiole. c Basidiospores. d Edge sterile hairs. e Caulocutis. f Epicutis. Scale bars: a = 1 cm, b–f = 10 µm. Redrawn: a = from Sánchez-García et al. (2014), b–f from Corriol & Jargeat (2019). For original basidiomata, refer to Sánchez-García et al. (2014) and inaturalist.org.

Dermoloma J.E. Lange ex Herink, Sborník Severočeského Musea, Historia Naturalis 1, 62

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 79

Classification: *Tricholomataceae, Tricholomatineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota*, *Fungi*

Dermoloma was introduced by Singer, designating *D. cuneifolium* (Fr.) Singer ex Bon (1986) as its type species (Sanchez-Garcia et al. 2021). *Dermoloma* is a member of the small brown mushrooms, referring to a hyperdiverse morphological group of fungi with complicated identification. *Dermoloma* species are globally distributed, and most of them have been discovered in temperate regions (Raj et al. 2014). They are saprobic, often growing gregariously in grasslands (Arnolds 1992, Kuo 2019). Ecologically, they align with *Clavariaceae* Chevall., *Hygrocybe* (Fr.) P. Kumm., *Entoloma* (Fr.) P. Kumm., and *Geoglossaceae* Corda, primarily inhabiting undisturbed,

conservation-value sites rather than areas with tree presence (Griffith et al. 2013). However, studies suggest that *Dermoloma* establishes unspecified biotrophic relationships with plants (Halbwachs et al. 2018) while showing a strong response to nutrient availability, particularly in traditionally managed grasslands (Sanchez-Garcia et al. 2021).

Morphologically, *Dermoloma* is identified by the presence of smaller basidiomata, strongly ventricose lamellae, brittle context, clavate caulocystidia, farinaceous odour, and pluristratous hymeniderm pileipellis composed of densely packed, broadly clavate or subglobose cells (Raj et al. 2014, Sanchez-Garcia et al. 2021). Usually, *Dermoloma* species lack hymenial cystidia (Voto 2021). However, *D. cystidiatum* from India, *D. cheilocystidiatum* from Sardinia, and *D. clavicystis* from the Mediterranean region are exceptions, as they are the first in the genus to possess cheilocystidia (Voto 2021). In the literature, there is an inconsistency in the amyloidity of *Dermoloma* basidiospores (Josserand 1958, Svrček 1966, Orton 1980, Bon 1986, Arnolds 1992). Weak amyloid reactions are common in some *Dermoloma* species, which appear as a grey hue under light microscopy (Sanchez-Garcia et al. 2021). Sanchez-Garcia et al. (2021) found no apparent differences in the amyloid reactions of *D. cuneifolium* and *D. alexandri* compared to previous reports, confirming that strong amyloid spores exhibit dark grey to black tints in mass.

The initial phylogenetic analysis involving a *Dermoloma* species, specifically *D. inconspicuum* Dennis, placed it near the genus *Lepiota* (Pers.) Gray within the *Agaricaceae* (Kropp 2008). Recent studies reaffirmed the placement of *Dermoloma* species within *Tricholomataceae*, identifying them as a sister clade to *Tricholoma* (Fr.) Staude, and the taxonomic identity of the genus was further clarified through the classification of its type species, *D. cuneifolium* (Sanchez-Garcia & Matheny 2016, Sanchez-Garcia et al. 2021). *Dermoloma* species were categorized into six sections: 1) *Dermoloma* subgenus *Dermoloma*: basidiomata typically exhibiting grey tints and inamyloid basidiospores, 2) *Dermoloma* subgenus *Amylospora* Adamčík: basidiomata mainly brown with amyloid basidiospores, 3) *Dermoloma* section *Dermoloma*: pileus convex and expanding to a plane, with basidiospores broadly ellipsoid to ellipsoid, 4) *Dermoloma* section *Conica* Adamčík, sectio nova: pileus conical, becoming plane with an umbo, and basidiospores ellipsoid to oblong, 5) *Dermoloma* section *Atrobrunnea* Contu: context colour unchanged when bruised, and 6) *Dermoloma* section *Nigrescentia* Adamčík, basidiomata context darkens when bruised (Sanchez-Garcia et al. 2021).

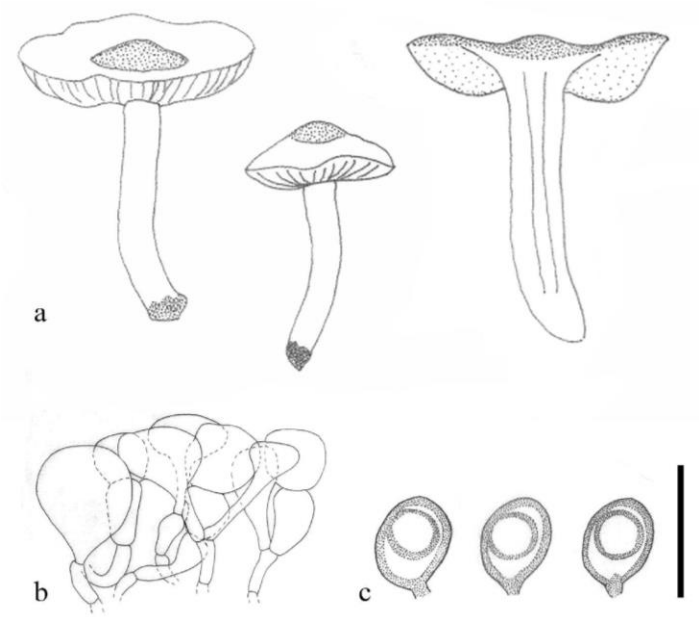


Fig. 79 – ***Dermoloma cuneifolium***. a Basidiomata. b Pileipellis (×1000). c Basidiospores. Scale bar: c = 10 μm. Redrawn from: a–b = Arnolds (1992) and c = gmvmonza.org. For original basidiomata, refer to inaturalist.org.

As a recent novel species, *D. clavicystis* was described by Voto (2021) based on morphological characteristics and phylogenetic analysis of the ITS region. A morphological similarity exists between *Dermoloma* J.E. Lange ex Herink and *Camarophyllopsis* Herink subgenus *Hodophilus* (R. Heim) Arnolds, as both have a pluristratous hymeniform pileipellis with brown parietal pigment. However, in *Camarophyllopsis* subgenus *Hodophilus*, the hymeniderm is loose and irregular, the lamellae are typically subdecurrent, whereas *Dermoloma* species often exhibit a sinuate gill edge (Arnolds 1992, Voto 2021). The classification of *Dermoloma* in *Tricholomataceae*, *Tricholomatineae*, *Agaricales*, *Agaricomycetidae, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* agrees in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a). Within *Dermoloma,* Species Fungorum (2026) lists 47 species worldwide.

Synonyms: *Tricholoma* subgen. *Dermoloma* J.E. Lange

Type species: *Dermoloma cuneifolium* (Fr.) Singer ex Bon

Basionym: *Agaricus cuneifolius* Fr.

Other accepted species: (Species Fungorum – search *Dermoloma*)

Porpoloma Singer, Sydowia 6(1–4), 198

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 80

Classification: *Tricholomataceae, Tricholomatineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota*, *Fungi*

Porpoloma was introduced by R. Singer in 1952, with *P. sejunctum* designated as its type species (Vizzini et al. 2012b). *Porpoloma* species are primarily saprotrophic, thriving in forested areas, particularly with coniferous trees (Arauzo 2012). They are also known to form ectomycorrhizal associations, and those associations were only found distributed in woods of the Magallanes region and the *Nothofagus* area (temperate regions of the Southern Hemisphere) (Singer 1952, Singer 1956, Sanchez-Garcia et al. 2014, Vizzini et al. 2016). Singer (1975) recognised the morphological heterogeneity of the genus early on, proposing three subgenera as *Porpoloma*, *Pseudotricholoma*, and *Pogonoloma* based on differences in pileipellis pigmentation type, availability of cheilocystidia, and trophic status (Vizzini et al. 2016). Subsequent molecular studies utilising the ITS region by Vizzini et al. (2012b) stated the polyphyletic status of *Porpoloma*. This was further strongly confirmed by Sanchez-Garcia et al. (2014) through multi-gene sequence analyses using LSU, SSU, and *rpb2* regions, placing its species into four distinct groups within the Tricholomatoid clade: *Porpoloma s.s.*, *Corneriella* Sanchez-García, *Pseudotricholoma* (Singer) Sanchez-Garcia & Matheny, and *Pogonoloma* (Singer) Sanchez-Garcia (Vizzini et al. 2016).

Porpoloma species typically produce small to medium-sized basidiomata with hygrophanous caps, which change colour depending on moisture levels (Arauzo 2012). They exhibit a tricholomatoid habit with non-decurrent lamellae that are inseparable from the pileus context and possess smooth, ellipsoid, amyloid basidiospores (Singer 1952, 1956, Bon 1991, Singer 1986, Vesterholt 2012, Vizzini et al. 2012b). The presence of cheilocystidia is variable, while pleurocystidia are absent (Sanchez-Garcia et al. 2014). Additionally, *Porpoloma* species possess a pileipellis with intracellular brown pigments and sterile lamellae edges, as well as well-differentiated cheilocystidia in some species (Singer 1956, Sanchez-Garcia et al. 2014, Vizzini et al. 2016).

Porpoloma is more similar to *Cantharellula* Singer, differing in the heteromorphous edge of the lamellae, which is non-decurrent to adnate, deeply and distinctly sinuate to emarginate, and having a constant ectomycorrhizal association with *Nothofagus* (Singer 1952). Additionally, the amyloid basidiospores, clamp-bearing hyphae, and lack of a veil distinguish *Porpoloma* from genera like *Tricholoma* and *Armillaria* (Singer 1952). The classification of *Porpoloma* in *Tricholomataceae*, *Tricholomatineae*, *Agaricales*, *Agaricomycetidae, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* agrees in Species Fungorum, MycoBank, GenBank, UNITE,

and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a). Within *Porpoloma,* Species Fungorum (2026) lists 13 species worldwide.

Type species: *Porpoloma sejunctum* Singer

Other accepted species: (Species Fungorum – search *Porpoloma*)

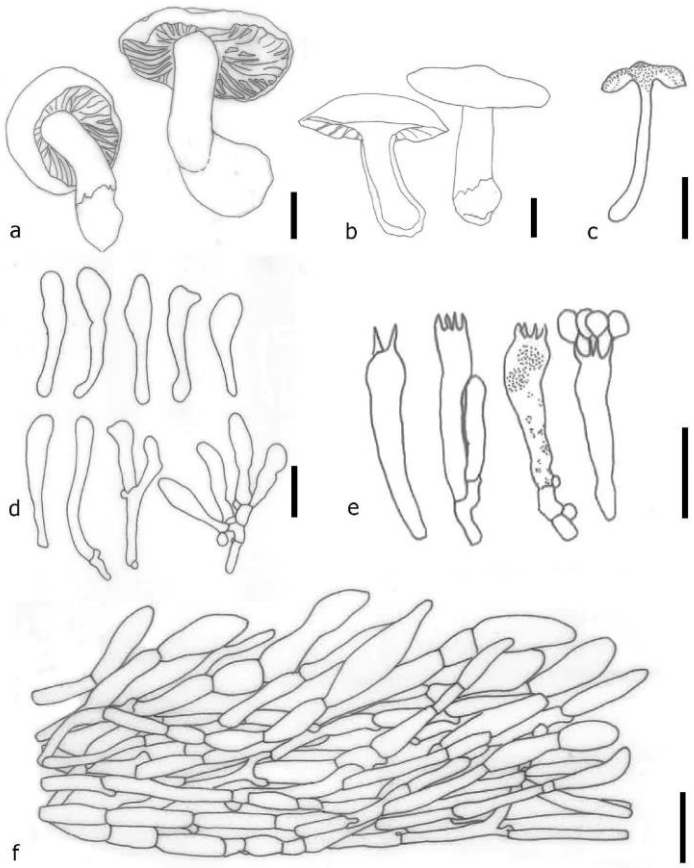


Fig. 80 – ***Porpoloma***. a–b Basidiomata of *P. sejunctum*. c Basidiomata of *P. mesotephrum*. d Cheilocystidia of *P. mesotephrum.* e Basidia of *P. mesotephrum.* f Pileipellis of *P. mesotephrum.* Scale bars a–c = 1 cm, d–e = 20 μm, f = 40 μm. Redrawn from Garrido et al. (2014), Sanchez-Garcia et al. (2014). For original basidiomata, refer to Sanchez-Garcia et al. (2014).

Pseudobaeospora Singer, Lloydia 5, 129

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 81

Classification: *Tricholomataceae, Tricholomatineae*, *Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota*, *Fungi*

Pseudobaeospora was established by R. Singer with its type species, *P. oligophylla*, based on a specimen collected from the Altai Mountains in central Asia (Singer 1942b, Wu et al. 2017a, Gisotti et al. 2021). In 2003, the genus was amended by Bas (Bas 2003). This genus is a saprotrophic and non-mycorrhizal, primarily found in terrestrial ecosystems, often found on conifer needle carpets, forest litter, humus, wooden debris, and fallen branches, among mosses and grasses (Bas 2003, Gisotti et al. 2021). The genus has a global distribution across temperate, subtropical, and tropical regions, including Asia, Europe, Hawaii, North and South America, and Slovakia (Vellinga 2001, 2009, Bas 2003, Adamcik & Jancovicova 2011, Schwarz 2012, Desjardin et al. 2014, Wu et al. 2017a).

Pseudobaeospora species are characterised by small, mycenoid to collybioid basidiomata, which are pink, violaceous, lilac, or occasionally whitish (Bas 2003). Pileus exhibits diverse shapes, including hemispherical, obtusely conical, paraboloid, plano-convex, or plano-conical, and with or without a small umbo or papilla. Initially, the margin is inflexed and minimally hygrophanous, with little or no striation along the edge, though smaller basidiomata may be

hygrophanous with translucent striations when moist. The surface texture varies from smooth to finely granular, fibrillose, felted, or subsquamulose, and often shows a micaceous or silvery appearance. The stipe is cylindrical to thread-like, sometimes tapering downward, with a fine pruinose or flocculose coating near the apex. The base may be glabrous to finely fibrillose or subtly flocculose, often covered with white tomentum or, rarely, yellow with rhizoids, and lacks velar remnants. The stipe and pileus context are concolourous or slightly lighter, with a mild, aromatic, weakly raphanoid, or faintly farinaceous odour. Lamellae are emarginate to free, widely spaced to crowded, and concolourous to the pileus (Bas 2003).

Microscopically, basidiospores are small, consistent in size, hyaline, and globose to ellipsoid with a smooth surface (Bas 2003). They possess a distinct, abrupt hilar appendage, lack a germ pore, and are colourless. Initially thin-walled and non-amyloid, they develop thick walls as they mature and exhibit weak to strong dextrinoid reactions, along with congophilous and cyanophilous properties. Spore prints are usually white or off-white. Sclerified basidia are common, while pleurocystidia are absent. Basidia are mostly 4-spored, sometimes 2-spored. Pileipellis structures are diverse, ranging from a simple cutis to a more intricate hymeniderm with repent or erect hyphae as cutis or trichodermium. Distinct pileocystidia are rare. Cheilocystidia, present in some species, are thin-walled and clavate, lageniform, utriform, subcylindrical, or irregularly shaped. Caulocystidia are thin-walled, clavate, subcylindrical, filiform, or irregular forms. The hymenophoral trama is mostly regular, sometimes inflated, and occasionally dextrinoid central hyphae. Clamp connections are common but may be absent in some species or limited to the basidia and subhymenium (Bas 2003).

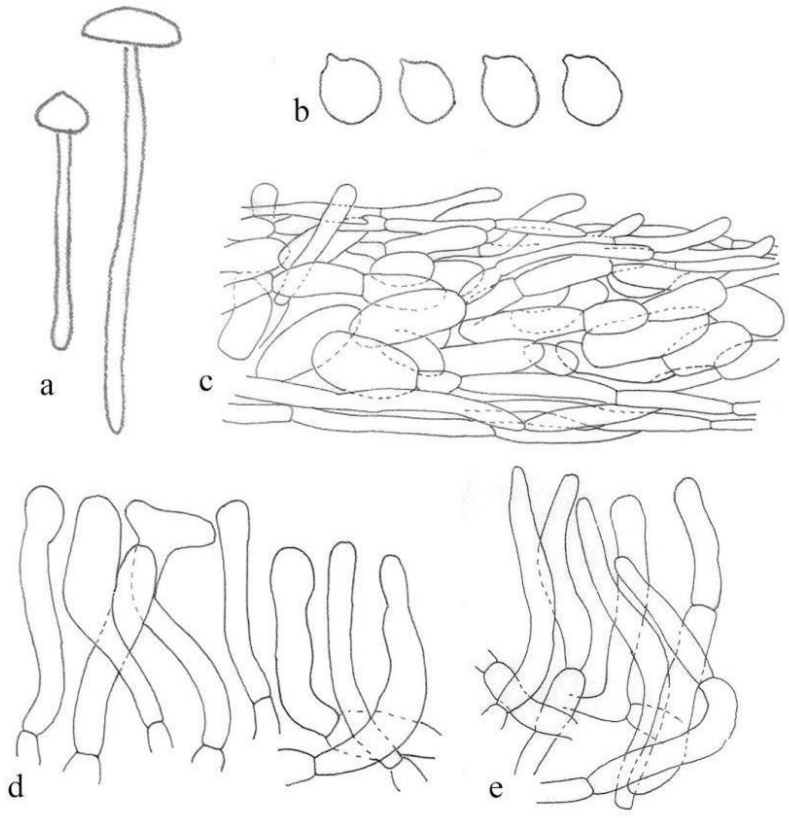


Fig. 81 – ***Pseudobaeospora oligophylla***. a Basidiomata (reconstructed) (×1). b Basidiospores (×1500). c Pileipellis (radial section) (×500). d Pileocystidia (from centre of pileus) (×1000). e Caulocystidia (×1000). Redrawn from Bas (2003). For original basidiomata, refer to Craig et al. (2023) and Gisotti et al. (2021).

Pseudobaeospora has recently expanded with the addition of two newly described species. *P. cortegadensis* was identified by De la Pena-Lastra and A. Mateos in the laurel forests of Spain (Crous et al. 2024), while *P. taluna* was discovered on soil in Tasmania, Australia, by S. Craig, L.J. Vaughan, and T.W. May (Craig et al. 2023). The genus is distinguished from the amyloid-spored genus *Baeospora* Singer by its small, thick-walled, mature spores and the presence of dextrinoid reactions (Craig et al. 2023). Phylogenetic classification of *Pseudobaeospora* species has been conducted using ITS and LSU gene regions (Gisotti et al. 2021). The classification of *Pseudobaeospora* in *Tricholomataceae*, *Tricholomatineae*, *Agaricales*, *Agaricomycetidae, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* agrees in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a). Within *Pseudobaeospora,* Species Fungorum (2026) lists 42 species worldwide.

Type species: *Pseudobaeospora oligophylla* Singer

Basiomym: *Baeospora oligophylla* Singer

Other accepted species: (Species Fungorum – search *Pseudobaeospora*)

Agaricales genera incertae sedis

Callistodermatium Singer, Mycologia 73(3), 506

Species Fungorum, Facesoffungi, MycoBank Fig. 82

Classification: *Incertae sedis*, *Agaricales*, *Agaricomycetes*, *Agaricomycotina*, *Basidiomycota*, *Fungi*

Callistodermatium is a monotypic genus of agaricoid fungi containing a single species, *Callistodermatium violascens* Singer (Singer 1981a, Hyde et al. 2024a). The classification of *Callistodermatium* in Species Fungorum and Hyde et al. (2024a) is under *Agaricales genus incertae sedis*, whereas MycoBank lists it under *Tricholomataceae* and may need updating.

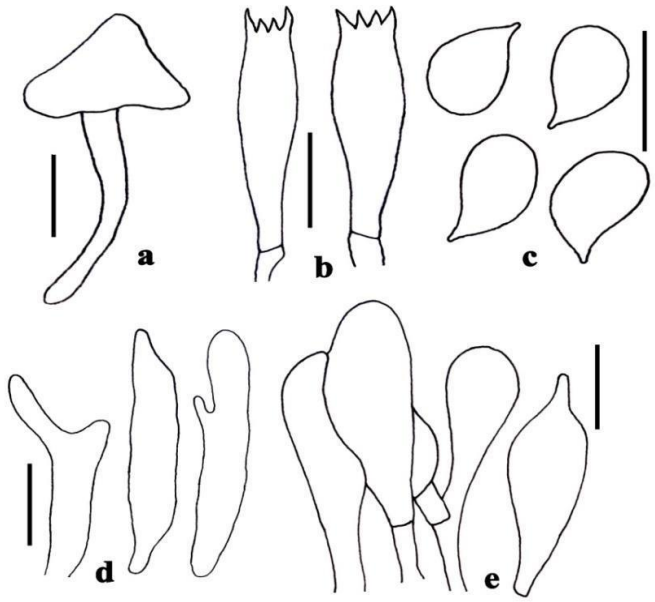


Fig. 82 – ***Callistodermatium violascens***. a Basidiomata. b Basidia. c Basidiospores. d. Cheilocystidia. e Dematocystidia of the pileus covering. Scale bars: a = 5mm, c = 5 µm, b, d–e = 10 µm. Redrawn from Singer (1981a).

Members of *Callistodermatium* typically display a collybioid habit, with terrigenous basidiomata bearing a central stipe and free to adnate lamellae (Singer 1981a). The pileus and stipe possess a superficial sterile layer formed from a trichodermis composed of palisaded, erect terminal hyphae. These hyphae contain a resinous, encrusting, straw-ochraceous pigment that is soluble in

alkaline solution. Basidiospores are inamyloid, small, hyaline, ellipsoid, and occasionally encrusted, typically lacking ornamentation. The hymenophoral trama is bilateral, and the hyphae are filamentous, thin-walled, and fibulate. A notable feature of this genus is the absence of true cystidia (Singer 1981a). At present, no sequence data are available for *Callistodermatium* (He et al. 2019).

Type species: *Callistodermatium violascens* Singer

Cymatella Pat., Bulletin de la Société Mycologique de France 15(3), 193

Species Fungorum, Facesoffungi, MycoBank Fig. 83

Classification: *Incertae sedis, Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Cymatella, a monotypic genus, was established by N.T. Patouillard in 1899, with its type species, *C. minima* (Patouillard 1899). This species was described based on specimens collected from rotten wood in the Antilles, Guadeloupe, France (Patouillard 1899). In the same year, Patouillard also transferred two species from *Craterellus* Pers. to *Cymatella*, namely *Cymatella marasmioides* (Berk. & M.A. Curtis) Pat. and *Cymatella pulverulenta* (Berk. & M.A. Curtis) Pat. (Patouillard 1899). In 1944, Martin described another new species, *C. longipes*, later reclassified as *Marasmius martini* Singer (Martin 1944, Singer 1958b). Members of *Cymatella* are saprophytic and are predominantly found in tropical regions, including Argentina, Bolivia, Brazil, Cuba, Ecuador, Ghana, Guadeloupe, Puerto Rico, the USA, and Venezuela (Burt 1924, GBIF 2025).

Cymatella is characterised by minute, marasmioid, stipitate basidiomata, which revive upon exposure to moisture (Patouillard 1899, Burt 1924). Pileus lacks a pellicle, and the hymenium is inferior, lacks lamellae, and is either even or slightly wavy (Burt 1924). The stipe is filiform, glabrous, black, thickened somewhat towards the base, and eccentrically inserted (Patouillard 1899). Basidiospores are ovoid, smooth, and hyaline, while basidia are clavate with four sterigmata. Cystidia are absent (Patouillard 1899).

Morphologically, this genus is closely related to *Marasmius* Fr. (Burt 1924). Species delineation of *Cymatella* from other genera is solely based on macro- and micro-morphology due to the lack of molecular sequences (He et al. 2019). The classification of *Cymatella* in Index Fungorum and Hyde et al. (2024a) is under *incertae sedis*, whereas MycoBank and UNITE lists it under *Marasmiaceae* and may need updating.

Type species: *Cymatella minima* Pat.

Other accepted species:

C. marasmioides (Berk. & M.A. Curtis) Pat.

C. pulverulenta (Berk. & M.A. Curtis) Pat.

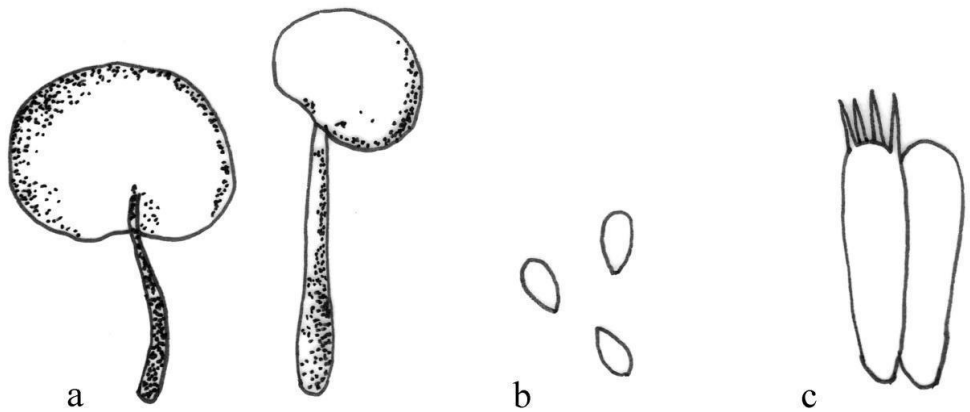


Fig. 83 – ***Cymatella minima***. a Basidiomata. b Basidiospores. c Basidia and basidiole. Redrawn from Patouillard (1899). For original basidiomata, refer to GBIF (2025).

Cyphellocalathus Agerer, Mycologia 73(3), 491

Species Fungorum, Facesoffungi, MycoBank Fig. 84

Classification: *Incertae sedis, Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Cyphellocalathus is a monotypic genus established by R. Agerer in 1981 with its type species, *C. cecropiae* (Agerer 1981, Hyde et al. 2024a). Initially, the species was classified within *Lachnella* Fr. as *L. cecropieae* and placed in *Lachnella* sect. *Metuloidifera* Sing. (Singer 1962c, 1966). This species was first described based on a specimen collected from leaves of *Cecropia* in Bolivia. Additionally, the species has been reported from Colombia (Vasco-Palacios & Franco-Molano 2013).

Species of *Cyphellocalathus* are characterised by their white, cup-shaped basidiomata, which may or may not have a stipe (Agerer 1981). The surface hairs are thick-walled, either scarcely encrusted or without encrustation, and exhibit dextrinoid reactions. The terminal cells of these hairs are rounded. The hymenium features dextrinoid metuloids encrusted with granular, angular crystals or an amorphous mass. Notably, crystals found on the surface of hairs and hymenium dissolve rapidly in concentrated HCl and slowly in 10% KOH. Basidiospores are smooth, thin-walled, hyaline, asymmetrically ellipsoidal or ovoidal, and neither amyloid nor dextrinoid. Basidia are suburniform and do not exceed 50 µm long (Agerer 1981).

The identification of *Cyphellocalathus* species relies entirely on macro- and micro-morphological characteristics due to a lack of molecular sequence (Agerer 1981, He et al. 2019). *Cyphellocalathus* is distinct from other members of cyphellaceous taxa; *Lachnella australis* Speg., *Chaetocalathus craterellus* (Durieu & Lév.) Singer, *Chaetocalathus liliputianus* (Mont.) Singer, *Crinipellis stipitaria* (Fr.) Pat. and *Rectipilus davidii* (D.A. Reid) Agerer by dextrinoid metuloids in the hymenium (Agerer 1981). Additionally, it is distinct from *Chaetocalathus* Singer by the absence of gills (Agerer 1981). The classification of *Cyphellocalathus* in Index Fungorum and Hyde et al. (2024a) is under *incertae sedis*, whereas MycoBank and UNITE list it under *Marasmiaceae* and *Tricholomataceae*, respectively and may need updating.

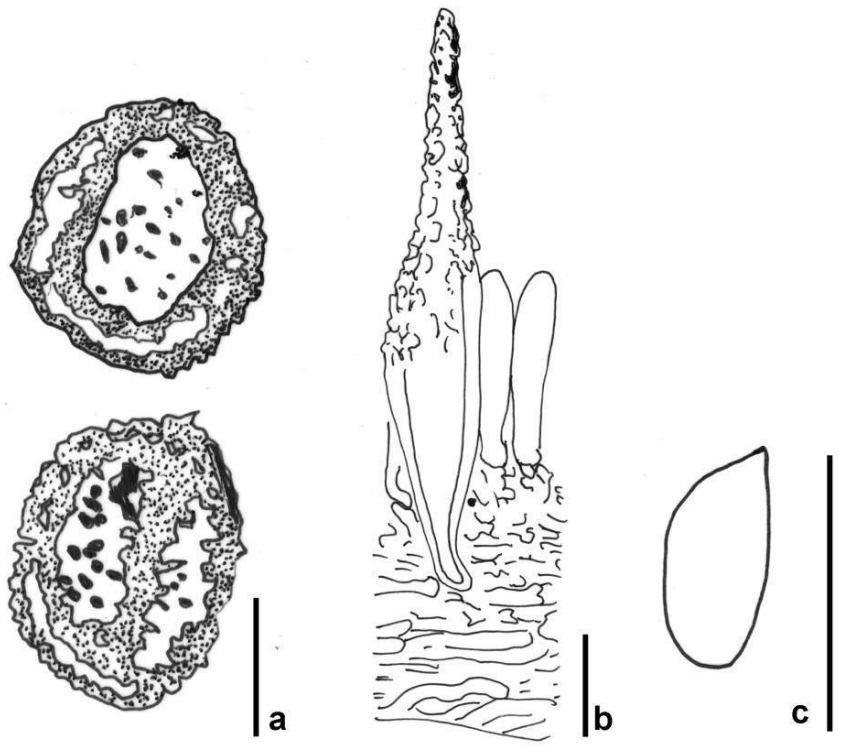


Fig. 84 – ***Cyphellocalathus cecropiae*** (BAFC, holotype). a Basidiomata. b Section through basidiomata. c Basidiospores. Scale bar: a = 0.6 mm, b–c = 20 µm. Redrawn from Agerer (1981).

Type species: *Cyphellocalathus cecropiae* (Singer) Agerer
Basionym: *Lachnella cecropiae* Singer

Lycogalopsis E. Fisch., Berichte der Deutschen Botanischen Gesellschaft 4, 197
Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 85
Classification: *Incertae sedis, Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Lycogalopsis was established by Edouard Fischer with *L. solmsii* as the type species (Fischer 1886). The type is considered rare and was described from specimens collected on the fruit of *Parinari scabra* and a tree trunk in Java (Fischer 1886, Demoulin et al. 2013). Members of the genus are lignicolous and distributed in tropical regions, including Brazil, Costa Rica, Mexico, and Venezuela (Calonge et al. 2005, He et al. 2019). Currently, Species Fungorum (2026) lists nine species of *Lycogalopsis*.

Members of *Lycogalopsis* are characterised by gasteroid basidiomata (Demoulin et al. 2013). The base of the basidiomata is sterile and becomes highly developed at maturity (Dodge & Zeller 1936). A well-developed subiculum is present on firm wood but conspicuous on plant debris (Demoulin et al. 2013). Basidiospores are globose, elongated, or somewhat irregular (Fischer 1886, Martin 1939). Basidia are elongated and 6–7-spored (Fischer 1886, Demoulin et al. 2013).

The taxonomic placement of *Lycogalopsis* remains unresolved, and the genus is currently treated as *incertae sedis* (He et al. 2019). In the tenth edition of the Dictionary of Fungi, it was placed in *Agaricaceae* Chevall. (Kirk et al. 2008). Hosaka (2005) suggested placement of *Lycogalopsis* in the gomphoid-phalloid clade, while LSU-based phylogenetic analysis by Demoulin et al. (2013) indicated a closer relationship to *Phallales* E. Fisch. and *Hysterangiales* K. Hosaka & Castellano, rather than *Geastrales* K. Hosaka & Castellano or *Gomphales* ss Jülich. However, limited sequence data from *Lycogalopsis* has been a limitation for its accurate classification (Demoulin et al. 2013). The classification of *Lycogalopsis* in Index Fungorum, GenBank, UNITE, and Hyde et al. (2024a) is under *incertae sedis*, whereas MycoBank lists it under *Agaricaceae* and may need updating.

Synonymy: *Enteromyxa* Ces.
Type species: *Lycogalopsis solmsii* E. Fisch.

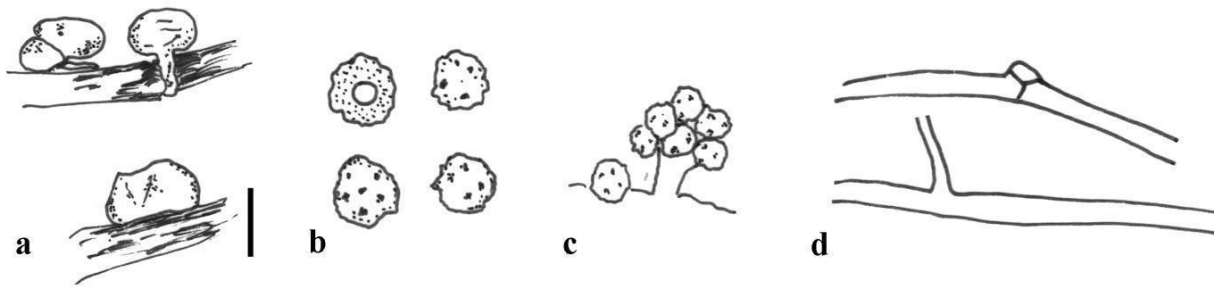


Fig. 85 – ***Lycogalopsis solmsii***. a Basidiomata. b Basidiospores (×1620). c Basidia with basidiospores (×952). d Hypahe from basal pad of mycelium (×810). Scale bar: a = 1 cm. Redrawn from: a = from Kotlaba & Zehnalek (2018), b–d = Coker & Hill (1930).

Other accepted species:
L. africana Har. & Pat.
L. dussii Pat.
L. hypostratosa Rick
L. hypoxilinoides Rick
L. leopoldensis Rick
L. reticulata Lloyd

L. subiculosa Lloyd
L. zeylanica Petch

Skepperiella Pilát, Bulletin Trimestriel de la Société Mycologique de France 43, 56
Species Fungorum, Facesoffungi, MycoBank Fig. 86
Classification: *Incertae sedis, Agaricales, Agaricomycetes, Agaricomycotina, Basidiomycota*, *Fungi*

Skepperiella was established by Pilát in 1927, with *S. spathularia* as the type species (Pilát 1927). The type species was initially classified as *Craterellus spathularius*, described based on specimens collected from dead wood in Cuba (Berkeley & Curtis 1869). Species of *Skepperiella* are lignicolous saprobes and are distributed in tropical regions (Pegler 1973). The classification of *Skepperiella* remains uncertain, although Pegler (1973) proposed its inclusion in *Tricholomataceae* R. Heim ex Pouzar (*Agaricales*) based on morphological features such as a monomitic hyphal system with inflated hyphae and the presence of a rameales-type structure on the pileal surface.

Skepperiella is characterised by nutant basidiomata with mesopodal to pleuropodal attachment, featuring a dorsally inserted pseudostipe and a hanging pileus (Pegler 1973). The pileus is an inverted cupulate, ranging from fleshy-firm to coriaceous in texture, convex, smooth to finely pruinose, and varies in colour from white to pale greyish or yellowish. Pileal surface is variable, consisting of repentant to erect hyphal terminations, sometimes forming a *Rameales*-type structure or presenting inflated hyphae. The margin is entire or crenate, straight, inflexed, or reflexed. The hymenium is initially smooth, then becomes plicate or forms anastomosis ridges, and eventually develops a strongly merulioid structure. The stipe is dorsally attached, centrally with strongly excentric attachment, filiform, solid, and ranges from pruinose to glabrous (Pegler 1973). The context is thin and firm. The hyphal system is monomitic, consisting of clamped generative hyphae that are hyaline, non-gelatinised, non-dextrinoid, and inamyloid. Basidiospores are minute, ovoid to ellipsoid, hyaline, thin-walled, inamyloid, and white in spore print. Basidia are narrowly clavate, typically 4-spored, and occasionally 2-spored. Hymenial cystidia originate from the tramal, emergent, hyaline, thin-walled, and stain positive with aniline blue (Pegler 1973). Dermatocystidia are scattered across both the pileal and stipe surfaces. The sub-hymenium layer is well-developed, composed of tightly interwoven hyphae (Pegler 1973).

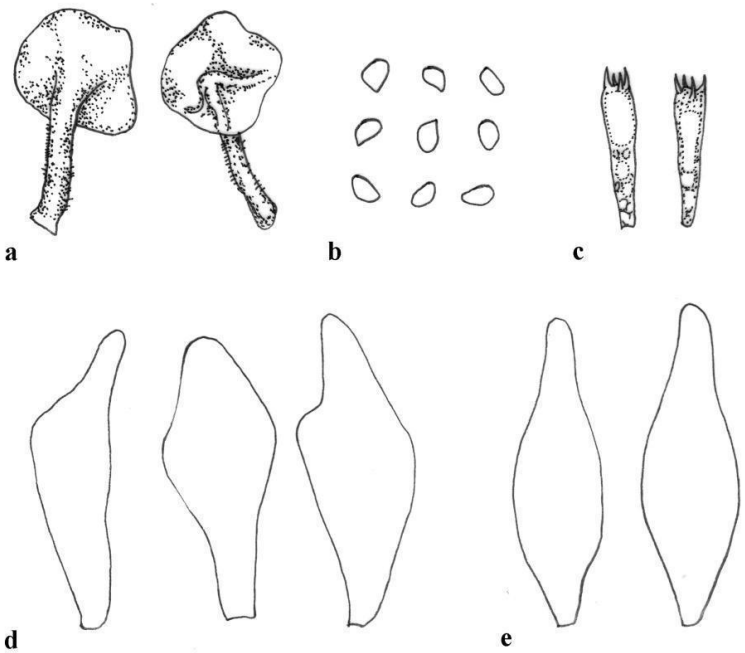


Fig. 86 – ***Skepperiella spathularia***. a Basidiomata (×6). b Basidiospores (×1000). c Basidia (×1000). d Hymenial cystidia (×1000). e Pileocystidia (×1000). Redrawn from Pegler (1973).

The identification of *Skepperiella* species is currently based on morphological characteristics, as molecular data remain unavailable (Pegler 1973, He et al. 2019). Currently, Species Fungorum (2026) lists four species of *Skepperiella*. *Skepperiella* is closely related to *Rhodoarrhenia* Singer, but the latter can be distinguished by its gelatinised context and the lack of hymenial cystidia (Pegler 1973). The classification of *Skepperiella* in Index Fungorum and Hyde et al. (2024a) is under *incertae sedis*, whereas MycoBank and UNITE list it under *Marasmiaceae* and may need updating.

Type species: *Skepperiella spathularia* (Berk. & M.A. Curtis) Pilát

Basionym: *Craterellus spathularius* Berk. & M.A. Curtis

Other accepted species:

S. cochlearis Pegler

S. merulioides (R. Heim) Pegler

S. populi Singer

Amylocorticiales K.H. Larss., Manfr. Binder & Hibbett, Mycologia 102(4), 871

Species Fungorum, Facesoffungi, MycoBank, GenBank

Amylocorticiaceae Jülich, Bibliotheca Mycologica 85, 354

Species Fungorum, Facesoffungi, MycoBank, GenBank

Classification: *Amylocorticiales, Agaricomycetes, Agaricomycotina, Basidiomycota*, *Fungi*

Amylocorticiaceae was established by W. Jülich (1982) with *Amylocorticium* Pouzar as the type genus (Jülich 1982). He et al. (2024) and Hyde et al. (2024a) have recognised 14 genera in this family: *Agroathelia* Redhead & Mullineux, *Amyloathelia* Hjortstam & Ryvarden, *Amyloceraceomyces* S.H. He, *Amylocorticiellum* Spirin & Zmitr., *Amylocorticium*, *Amyloxenasma* (Oberw.) Hjortstam & Ryvarden, *Anomoloma* Niemelä & K.H. Larss., *Anomoporia* Pouzar, *Ceraceomyces* Jülich, *Irpicodon* Pouzar, *Plicatura* Peck, *Plicaturopsis* D.A. Reid, *Podoserpula* D.A. Reid, and *Serpulomyces* (Zmitr.) Zmitr. Members of *Amylocorticiaceae* are distributed worldwide and are saprophytic (He et al. 2019).

Amyloathelia Hjortstam & Ryvarden, Mycotaxon 10(1), 201

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 87

Classification: *Amylocorticiaceae, Amylocorticiales, Agaricomycetes, Agaricomycotina, Basidiomycota*, *Fungi*

Amyloathelia was proposed by Hjortstam & Ryvarden in 1979, with its type species *A. amylacea* (Hjortstam & Ryvarden 1979, Larsson 2007). The genus was given its name due to the presence of distinct amyloid spore walls, using the term "*amylo*" and separating it from *Athelia* Pers. (Hjortstam & Ryvarden 1979). Currently, two more species were described, *A. crassiuscula* Hjortstam & Ryvarden from Norway and *A. aspera* Hjortstam & Ryvarden from Chile (Pérez Gorjón & Bernicchia 2009). This genus is prevalent on woody conifers like *Thuja* in North America, *Juniperus* in Europe, and the species are widely distributed throughout the Northern Hemisphere, with a rare distribution in Europe (France, Germany, and Italy) and the Iberian Peninsula (Hjortstam & Ryvarden 1979, Ginns & Lefebvre 1993, Pérez Gorjón & Bernicchia 2009).

The basidiomata are whitish to light ochraceous, resupinate, effuse, loosely adnate, byssoid to pellicular, and distinctly membranaceous with indeterminable or slightly fibrillose margins (Hjortstam & Ryvarden 1979). Basidiospores are thick-walled, smooth, amyloid, in known species, ellipsoid to subglobose. Cystidia are lacking but mostly with hyphal ends (paraphysoids) between the basidia, which vary in shape, clavate, in some cases are suburniform, terminal with more or less tapering bases or sometimes lateral. Hyphal system monomitic, thin to becoming thick-walled, straight and uniform, sometimes encrusted basal hyphae; subhymenial hyphae, irregular, sinuous, all hyphae with clamps (Hjortstam & Ryvarden 1979).

Molecular studies do not clarify the phylogenetic relationships of *Amyloathelia* with other corticoid genera, and it was provisionally grouped into *Amylocorticiaceae* Jülich, along with other corticoid fungi that have amyloid spores (Hibbett et al. 2007, Larsson 2007, Wijayawardene et al. 2022). The type species of the genus *A. amylacea* has similar basidia as in *Melzercium* Hauerslev but is well separated by its thick-walled spores (Hjortstam & Ryvarden 1979, Pérez Gorjón & Bernicchia 2009). The strongly amyloid spore wall easily separates *Amyloathelia* from *Dendrothele* Höhn. & Litsch., whereas later presents more or less abundant dendrophyphidia, but otherwise, spores in both species have a similar appearance (Pérez Gorjón & Bernicchia 2009). Additionally, *Aleurodiscus s.l.* is clearly differentiated from *Amyloathelia* in exhibiting a wide variety of sterile elements that are absent in *Amyloathelia*, which instead have paraphysoid hyphal endings (Hjortstam & Ryvarden 1979). The classification of *Amyloathelia* in *Amylocorticiaceae, Amylocorticiales, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* agrees in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a). Currently, Species Fungorum (2026) lists three species of *Amyloathelia*.

Type species: *Amyloathelia amylacea* (Bourdot & Galzin) Hjortstam & Ryvarden

Basionym: *Corticium amylaceum* Bourdot & Galzin

Other accepted species:

A. aspera Hjortstam & Ryvarden

A. crassiuscula Hjortstam & Ryvarden

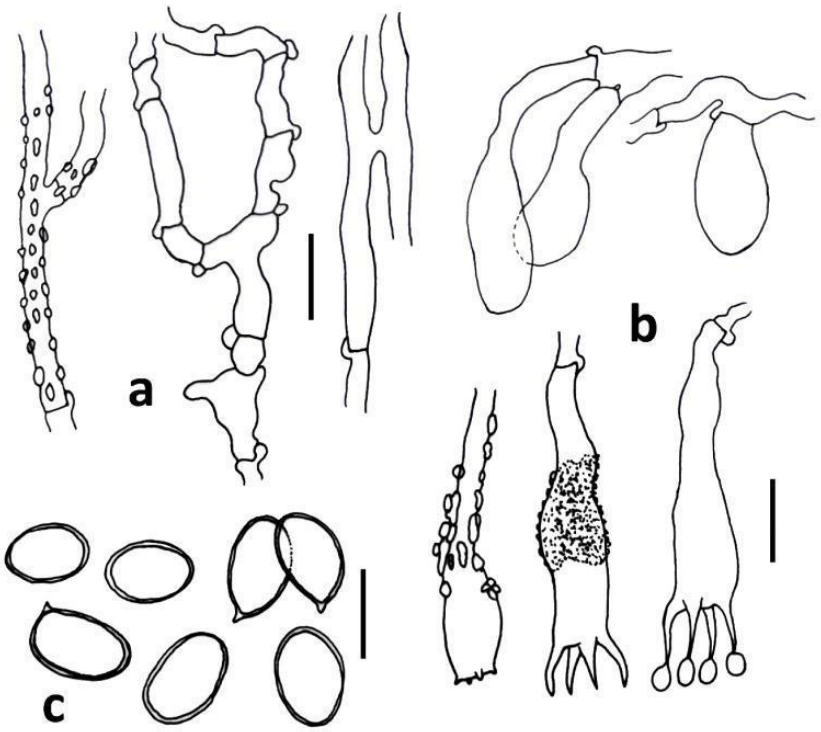


Fig. 87 – ***Amyloathelia amylacea*** (Galzin 6264, holotype). a Hyphae. b Basidia and basidioles. c Basidiospores. Scale bars: a–c = 10 µm. Redrawn from Hjortstam & Ryvarden (1979). For original basidiomata, refer to Pérez Gorjón & Bernicchia (2009).

Amylocorticiellum Spirin & Zmitr., Mikologiya i Fitopatologiya 36(1), 22

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 88

Classification: *Amylocorticiaceae, Amylocorticiales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Amylocorticiellum was described by Zmitrovich and Spirin with *A. subillaqueatum* as its type species (Zmitrovich & Spirin 2002). Members of the genus are found as saprobic and pathogenic

fungi on a wide variety of plant species across various continents, excluding Antarctica and Africa (Gorjón et al. 2011). Currently, Species Fungorum (2026) lists seven species of *Amylocorticiellum*. Most species of *Amylocorticiellum* are located on the twigs and logs of *Nothofagus* members. They are distributed in regions including Argentina, the Canary Islands, Chile, Europe, North and South America, New Zealand, and Russia (Gorjón et al. 2011).

Amylocorticiellum is characterised by its effused resupinated basidiomata, which feature effused, pellicular to membranous, and fibrous margins (Gorjón et al. 2011). The hymenophore is smooth to merulioid or hydnoid and typically light-colored. Basidia are clavate, coiled, and possess a basal clamp, while basidiospores are cylindrical to ellipsoid, smooth, thick-walled, and exhibit a greyish to bluish reaction in Melzer's reagent. Cystidia are usually absent or only poorly differentiated. The hyphal system is monomitic, comprising hyphae with distinct, thin to thick-walled brackets in the subiculum (Gorjón et al. 2011). The classification of *Amylocorticiellum* in Species Fungorum, GenBank, UNITE, and Hyde et al. (2024a) is under *Amylocorticiaceae*, whereas MycoBank lists it under *Coniophoraceae* and may need updating.

Type species: *Amylocorticiellum subillaqueatum* (Litsch.) Spirin & Zmitr.

Basionym: *Corticium subillagueatum* Litsch.

Other accepted species:

A. cremeoisabellinum (Litsch.) Spirin & Zmitr.
A. iaganicum (Speg.) Gorjón, Gresl. & Rajchenb.
A. luteolum (Hjortstam & Ryvarden) Gorjón, Gresl. & Rajchenb.
A. molle (Fr.) Spirin & Zmitr.
A. oblongisporum (G. Cunn.) Gorjón, Gresl. & Rajchenb.
A. sinuosum Spirin & Zmitr.

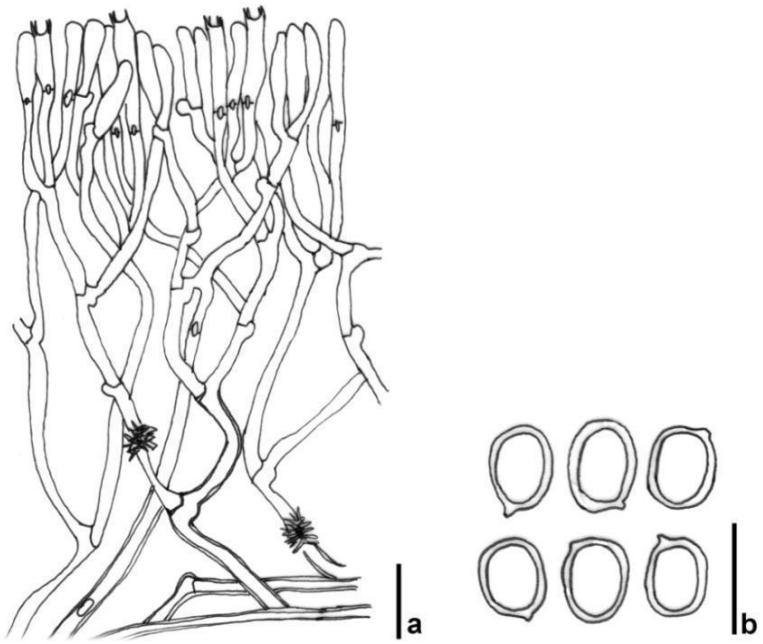


Fig. 88 – ***Amylocorticiellum iaganicum*** (AG 1507). a Cross-section of basidiomata. b Basidiospores. Scale bars: a = 25 µm, b = 10 µm. Redrawn from Gorjón et al. (2011). For original basidiomata, refer to GBIF (2024).

Amylocorticium Pouzar, Česká Mykologie 13(1), 11

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 89

Classification: *Amylocorticiaceae, Amylocorticiales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Amylocorticium was established by Pouzar in 1959 to accommodate a group of species closely related to *Athelia* Pers. emend. Donk and also allied with *Gloeocystidiellum* Donk (Liberta 1968). The species initially classified under *Amylocorticium* by Pouzar are distinguished by their effused, pelliculose to submembranous basidiomata, which often exhibit a purple colour change when exposed to KOH (Pouzar 1959, Liberta 1968). Additionally, these species are characterised by the absence of gloeocystidia, the presence of distinctive hyphae, and ovoid to cylindrical amyloid basidiospores (Pouzar 1959). They also have resupinate (crust-like) basidiomata, which typically grow on decaying wood, and the species often exhibit amyloid reactions in their spores- a key diagnostic feature (Hjortstam & Ryvarden 1980). *Amylocorticium* species, particularly *A. subincarnatum*, are vital wood-decaying fungi that significantly contribute to the health of forest ecosystems (Binder et al. 2010). These fungi, prevalent in coniferous forests, play a crucial role in the decomposition of dead wood, facilitating nutrient cycling (Binder et al. 2010). The type species of the genus is *A. subincarnatum*, which was first described by Hjortstam and Ryvarden (1980).

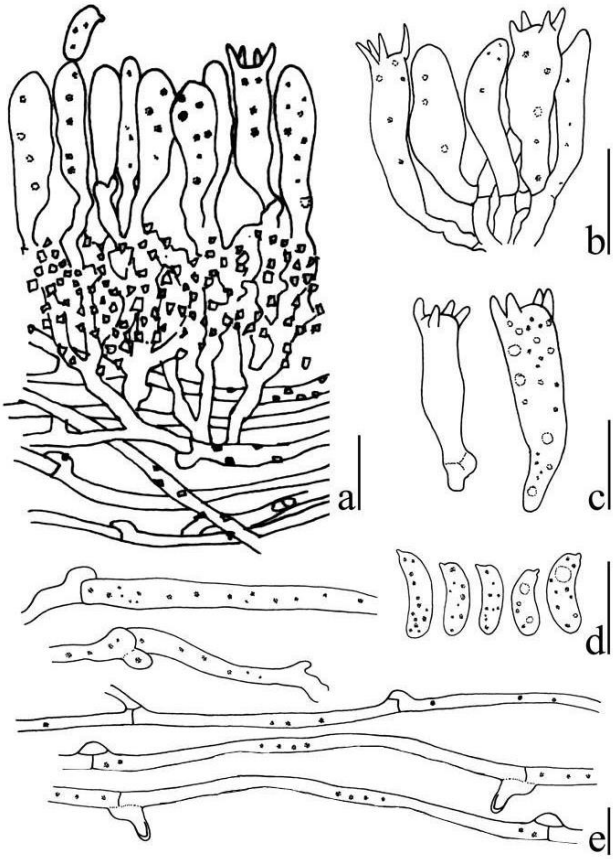


Fig. 89 – ***Amylocorticium laceratum***. a Vertical section through basidiomata. b Fragment of hymenium. c Basidia d. Basidiospores. e Subicular hyphae. Scale bars: a–d = 10 µm, e = 5 µm. Redrawn from Yurchenko & Wołkowycki (2023). For original basidiomata, refer to Yurchenko & Wołkowycki (2023). Drawings by Didsanutda Gonkhom.

Currently, molecular data from Binder et al. (2010), using ITS, LSU, SSU, *rpb1*, *rpb2*, and *tef-1α*, support its phylogenetic placement within *Amylocorticiales*. However, the genus-level classification remains uncertain (Yurchenko & Wołkowycki 2023). Currently, Species Fungorum (2026) lists 16 species of *Amylocorticium*. While taxonomically related to genera like *Anomoloma* and *Amyloxenasma*, *Anomoloma* differs in its dimitic hyphae, and *Amyloxenasma* frequently presents effused-reflexed fruiting structures (Wu et al. 2019b). Interestingly, *A. laceratum* has a Eurasian distribution, ranging from Norway, Sweden, Spain, and Turkey (Eriksson & Ryvarden 1973, Bernicchia & Gorjón 2010). It also occurs in isolated environments, such as the North Urals (Kotiranta & Penzina 1998) and China (Dai 2011). However, a literature search of other species

suggested limited distribution. The classification of *Amylocorticium* in *Amylocorticiaceae, Amylocorticiales, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* agrees in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Type species: *Amylocorticium subsulphureum* (P. Karst.) Pouzar

Basionym: *Corticium subsulphureum* P. Karst.

Other accepted species: (Species Fungorum – search *Amylocorticium*)

Anomoloma Niemelä & K.H. Larss., Niemelä, Larsson, Dai & Larsson, Mycotaxon 100, 312

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 90

Classification: *Amylocorticiaceae, Amylocorticiales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Anomoloma, described by Niemelä et al. (2007), is characterised by resupinate, strongly rhizomorphic basidiomata with white, cream, or yellow surfaces; a monomitic hyphal system featuring clamped generative hyphae; and elliptical, slightly thick-walled basidiospores (Niemelä et al. 2007). *Anomoloma* was proposed to include species with a resupinate monomitic hyphal system and amyloid spores, encompassing both brown and white rot species. Phylogenetic analysis revealed that four white-rot fungi were segregated into *Anomoloma*, which typically grows on the debris of angiosperms and gymnosperms (Niemelä et al. 2007). Later, Song et al. (2016) and Zhou et al. (2022) proposed four new species from China to be included in *Anomoloma*, based on both morphological and phylogenetic evidence. They also provided a key to all species within the genus. Phylogenetic studies place *Anomoloma* in a sister sub-clade with *Amylocorticium* (Song et al. 2016, Zhou et al. 2022).

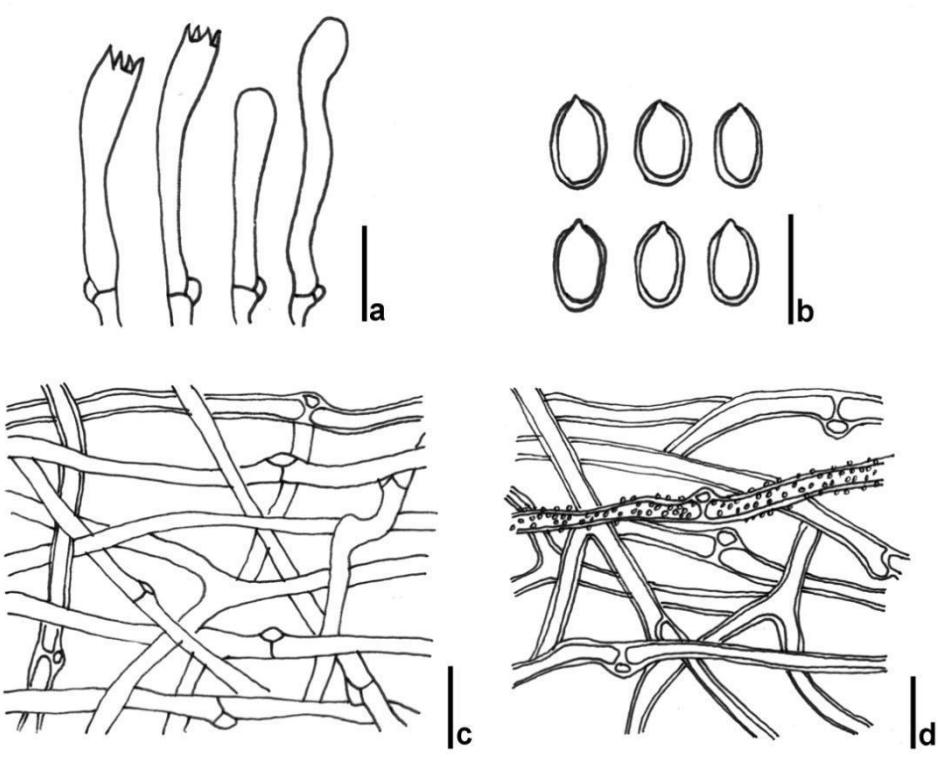


Fig. 90 – ***Anomoloma submyceliosum*** (BJFC 000070, holotype). a Basidia and basidioles. b Basidiospores. c Hyphae from trama. d Hyphae from subiculum. Scale bars: a, c–d = 10 μm, b = 5 μm. Redrawn from Song et al. (2016). For original basidiomata, refer to Song et al. (2016).

Most species are found in subtropical regions. Currently, *Anomoloma* consists of eight species (Niemelä et al. 2007, Song et al. 2016, Zhou et al. 2022). These species are typically found

on angiosperm stumps, dead *Abies* wood, rotten *Picea* wood, and the trunks of *Pinus*, with a predominant distribution in China (Zhou et al. 2022). Molecular analyses of *Anomoloma* species involve multigene sequences, including ITS, LSU, SSU, *rpb2*, and *tef-1α* (NCBI 2024). The classification of *Anomoloma* in *Amylocorticiaceae, Amylocorticiales, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* agrees in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Type species: *Anomoloma albolutescens* (Romell) Niemelä & K.H. Larss.

Other accepted species:

A. denticulatum Y.C. Dai, Vlasák & Meng Zhou
A. eurasiaticum Y.C. Dai, Vlasák & Meng Zhou
A. flavissimum (Niemelä) Niemelä & K.H. Larss.
A. luteoalbum J. Song & B.K. Cui
A. myceliosum (Peck) Niemelä & K.H. Larss.
A. rhizosum Niemelä & K.H. Larss.
A. submyceliosum J. Song & B.K. Cui

Anomoporia Pouzar, Česká Mykologie 20(3), 172

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 91

Classification: *Amylocorticiaceae, Amylocorticiales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Anomoporia was established by Zdeněk Pouzar in 1966 with the type species *A. bombycina* (Pouzar 1966a). The species in this genus are characterised by resupinate, soft to corky basidiomata and a monomitic hyphal system with clamped generative hyphae (Binder et al. 2010). Most *Anomoporia* species are predominantly distributed across the boreal and temperate regions of the Northern Hemisphere (Niemelä 1994). In Europe, *A. bombycine* is commonly found in Scandinavia, while *A. kamtschatica* has been recorded in Finland and the Czech Republic (Niemelä 1994). In Asia, *A. vesiculosa* is known from China's Changbai Mountains (Dai & Niemelä 1994), and *A. flavissima* occurs in the Russian Far East (Dai & Niemelä 1994). In North America, *A. albolutescens* is widespread in the USA and Canada, and *A. myceliosa* is found in the Pacific Northwest (Niemelä 1994).

Members of *Anomoporia* are characterised by white to cream or yellowish resupinate basidiomata with some species displaying rhizomorphs (e.g., *A. albolutescens*) and some without (e.g., *A. kamtschatica*) (Niemelä 1994). Pores are angular to round and vary in density among species (Niemelä 1994). The hyphal system is monomitic, with clamp connections present, and subicular hyphae may be thick-walled and encrusted with crystals (Dai & Niemelä 1994). Basidiospores are ellipsoid, amyloid, and acyanophilous, with size variations, critical for species delineation (Dai & Niemelä 1994, Niemelä 1994). Molecular markers (ITS and LSU) are employed to delineate species in *Anomoloma* (Niemelä et al. 2007).

Anomoporia species play an important role in wood decomposition, primarily causing white rot in both angiosperms and gymnosperms, thereby contributing to nutrient cycling in forest ecosystems (Niemelä 1994). These fungi are typically associated with late-stage wood decomposition in old-growth forests, often fruiting on extensively decayed logs or stumps. Due to their habitat specificity, several species, such as *A. bombycina*, are considered rare or threatened, particularly in Europe, where old-growth forests have experienced significant decline (Niemelä 1994). The classification of *Anomoporia* in Species Fungorum, GenBank, UNITE, and Hyde et al. (2024a) is under *Amylocorticiaceae*, whereas MycoBank lists it under *Fomitopsidaceae* and may need updating. Currently, Species Fungorum (2026) lists seven species of *Anomoporia*.

Type species: *Anomoporia bombycina* (Fr.) Pouzar

Basionym: *Polyporus bombycinus* Fr.

Other accepted species:

A. ambigua A. David & Gilles
A. dumontii Hjortstam & Ryvarden

A. irpicoides Hjortstam & Ryvarden
A. kamtschatica (Parmasto) Bondartseva
A. neotropica Ryvarden
A. vesiculosa Y.C. Dai & Niemelä

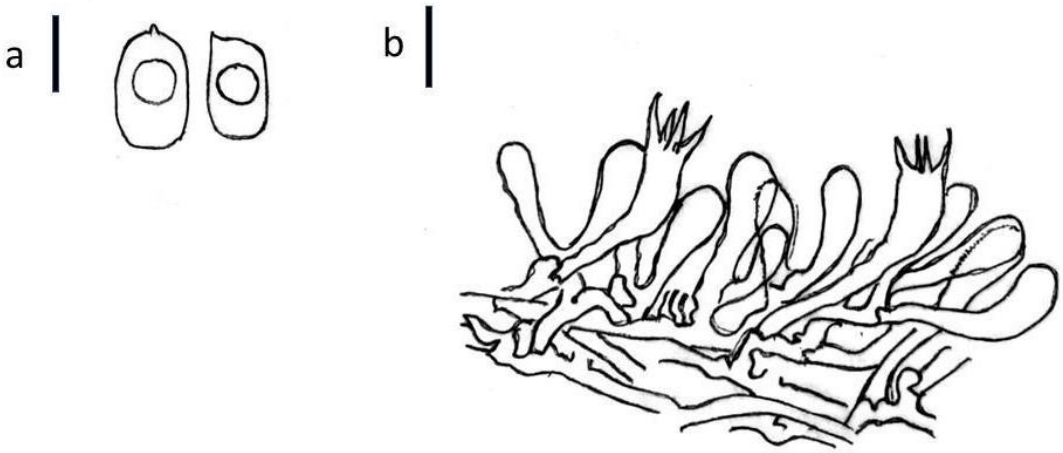


Fig. 91 – ***Anomoporia bombycina***. a Basidiospores. b Hymenium and subhymenium. Scale bars: a = 5 μm, b = 10 μm. Redrawn from Niemelä (1994). For original basidiomata, refer to Niemelä (1994).

Ceraceomyces Jülich, Willdenowia, Beiheft 7, 146
Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 92
Classification: *Amylocorticiaceae, Amylocorticiales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Ceraceomyces was initially placed in *Corticiaceae* Herter by Julich (Julich 1972). The name of the genus was derived from the word "ceraceus", meaning waxy mushroom, due to the presence of a thin and waxy hymenial layer (Julich 1972). The type species *Ceraceomyces tessulatus* (Cooke) Jülich was initially classified as *Corticium tessulatum* Cooke described based on a specimen from South Carolina (Julich 1972). They were recently assigned to *Amylocorticiaceae* Jülich (Binder et al. 2010). Currently, Species Fungorum (2026) lists 17 species of *Ceraceomyces*. Members belonging to this genus grow on rotten wood of coniferous and deciduous trees (Chikowski et al. 2017). The genus is distributed worldwide, from North America, Austria, Canada, Czechoslovakia, Finland, France, Germany, Great Britain, the Netherlands, Norway, Poland, Sweden, the USA, and Russia (Julich 1972, Chikowski et al. 2017).

Ceraceomyces is characterised by waxy-membranous, resupinate, annual, pellicular basidiomata with a smooth or merulioid hymenial surface, which is thin and membranous and easily separated from the substrate. The margins are fibrillar or arachnoid and indistinctly separated (Julich 1972). The hymenial region is smooth, cream or pale coloured. Basidiospores are hyaline, smooth, thin to somewhat thick-walled, non-amyloid, usually with oil drops (Julich 1972, Eriksson & Ryvarden 1973). Basidia are elongated to narrowly clavate, with 2–4 sterigmata. The hyphal system is monomitic, with clamps present at all septa (Julich 1972).

Molecular phylogenetic studies have been conducted using ITS and LSU markers (Larsson et al. 2004). Phylogenetic analysis revealed that the genus had a polyphyletic origin, comprising three distinct groups, with the type species *Corticium tessulatum* belonging to a separate clade in *Polyporales* Gäum., and *Ceraceomyces serpens* (Tode) Ginns and *C. eludens* K.H. Larss. were part of the phlebioid clade (Larsson et al. 2004). More recent phylogenetic analyses have added more insights to the polyphyletic origin of the genus and have led to retaining seven species in the genus (Chikowski et al. 2017, Yuan et al. 2023). However, authentic specimens and DNA data are lacking for *Ceraceomyces* species.

Ceraceomyces is closely related to *Athelia* Pers., which showed the presence of bushes of basidia densely packed together at about the same level. *Ceraceomyces* has a thin, waxy hymenial layer, long, slender basidia varying in their arrangement, which become more spread out, and the basidiomata become thicker with increasing age and the older basidia are much deeper than the newly created basidia (Julich 1972). The two species, *C. sublaevis* and *Trechispora confinis,* have often been confused because of similarity in their spores, but the basidia of the former are twice as large as those of the latter (Julich 1972). The classification of *Ceraceomyces* in *Amylocorticiaceae, Amylocorticiales, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* agrees in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Type species: *Ceraceomyces tessulatus* (Cooke) Jülich

Basionym: *Corticium tessulatum* Cooke

Other accepted species:

C. cystidiatus (J. Erikss. & Hjortstam) Hjortstam

C. eludens K.H. Larss.

C. microsporus K.H. Larss.

C. sublaevis (Bres.) Jülich

C. rhizomorphus C.L. Zhao & H.M. Zhou

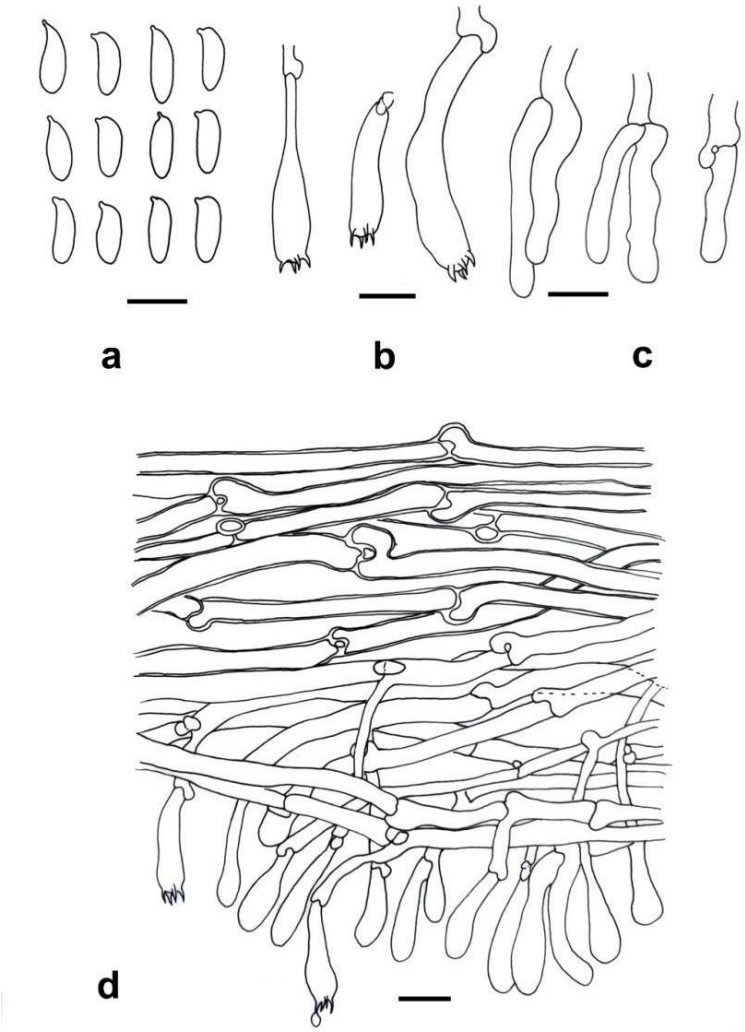


Fig. 92 – ***Ceraceomyces rhizomorphus*** (CLZhao 31188, holotype). a Basidiospores. b Basidia. c Basidioles. d A section of hymenium. Scale bars: a = 5 μm, b–d = 10 μm. Redrawn from Zhou et al (2024). For original basidiomata, refer to Zhou et al (2024).

Irpicodon Pouzar, Folia Geobotanica et Phytotaxonomica Bohemoslovaca 1, 371

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 93

Classification: *Amylocorticiaceae, Amylocorticiales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Irpicodon, a monotypic genus, was established by Pouzar in 1966 to accommodate *Sistotrema pendulum*, a wood-inhabiting fungus. The genus is characterised by its monomitic hyphal system, amyloid basidiospores, and lack of cystidia, distinguishing it from the dimitic, inamyloid *Irpex* Fr. (Pouzar 1966b). *Irpicodon pendulus*, the type and sole species, forms small, pendant basidiomata with irregularly aculeate hymenophores, typically found on *Pinus sylvestris* in old-growth forests (Eriksson & Ryvarden 1976).

Recent phylogenetic analyses integrating ITS, LSU, and *rpb2* data revealed that *Irpicodon* forms a well-supported clade with *Plicatura* Peck and *Plicaturopsis* D.A. Reid, sharing ecological roles as white-rot fungi and congruent micro-morphological traits (Palla et al. 2024). Due to strong monophyly and overlapping characteristics, *Irpicodon* and *Plicaturopsis* were synonymised under the earlier-described *Plicatura*, with *I. pendulus* recombined as *Plicatura pendula*. The genus name *Irpicodon* is now retained as a subgenus under *Plicatura*.

Irpicodon species are ecologically significant as indicators of old-growth forests, particularly in Central Europe (Palla et al. 2024). The genus was historically confused with *Hydnum* L. and *Irpex* due to similarities in hymenophores; however, molecular tools resolved its placement in *Amylocorticiaceae* (Binder et al. 2010). Related genera, such as *Amylocorticium* and *Anomoporia,* differ in resupinate basidiomata and smooth or poroid hymenophores (Larsson 2007). This genus is primarily reported in Europe, including Germany and Hungary, and is associated with *Pinus sylvestris* (Bernicchia & Gorjón 2020). The classification of *Irpicodon* in Species Fungorum, MycoBank, UNITE, and Hyde et al. (2024a) is under *Amylocorticiaceae*, whereas GenBank lists it under *Atheliaceae* and may need updating.

Type species: *Irpicodon pendulus* (Alb. & Schwein.) Pouzar

Basionym: *Plicatura* subgen. *Irpicodon* (Pouzar) B. Palla, V. Papp & Dima

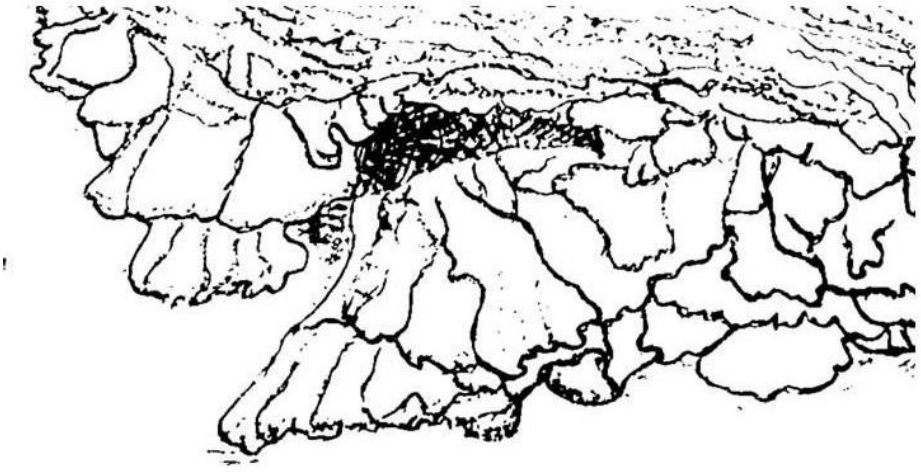


Fig. 93 – Basidiomata of ***Plicatura pendula***. Redrawn from Palla et al. (2024). For original basidiomata, refer to Palla et al. (2024).

Plicaturopsis D.A. Reid, Persoonia 3(1), 150

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 94

Classification: *Amylocorticiaceae*, *Amylocorticiales*, *Agaricomycetes*, *Agaricomycotina*, *Basidiomycota*, *Fungi*

Plicaturopsis is a small corticioid–stereoid genus established by Reid within the family *Amylocorticiaceae* Jülich of order *Amylocorticiales* K.H. Larss. (Reid 1964). This genus is

represented by the type species *Plicaturopsis crispa* (Pers.) D.A. Reid, which was originally described as *Merulius crispus* (Pers.) Pers. and until Reid (1964) separated it based on its distinctive basidiomata morphology and anatomical features.

Members of *Plicaturopsis* are characterised by pendent basidiomata that are cupulate, flabellate, or reniform. They are dorsally attached by a short stipe, and sometimes arise laterally with unequal expansion, and in some cases, adjacent pilei are often confluent or lobed. The pileus is membranaceous, flaccid, and sulcate-zonate, and under magnification, it appears villose. It is white when young but becomes reddish-brown with age. The hymenial surface is initially smooth, but later develops densely crowded, radiating, dichotomously branched, gill-like folds. The stipe is short or rudimentary. Microscopically, the hyphal system is monomitic, and hyphae are hyaline with clamp connections. The outer context hyphae are thick-walled and yellowish, while the subhymenial hyphae are strongly thickened or gelatinised and refractive. The outer surface is covered with long, thick-walled hairs bearing clamped septa. These taper gradually to an obtuse apex. Cystidia and gloeocystidia are absent. Basidia are small, irregularly cylindrical, and apically constricted. Basidiospores are minute, hyaline, and narrowly allantoid to narrowly elliptical (Reid 1964).

Plicaturopsis resembles *Plicatura* Peck and *Phlebia* Fr. in possessing plicate to merulioid hymenophores. However, it can be distinguished by its more delicate, thin, and regularly folded basidiomata with relatively limited variability (Reid 1964). In contrast, Gorjón (2020) treated *Plicaturopsis* as a synonym of *Plicatura*, arguing that no reliable morphological or molecular characters justify their separation. Nevertheless, the interpretation of Hyde et al. (2024a), *Plicaturopsis* is currently accepted as a distinct genus.

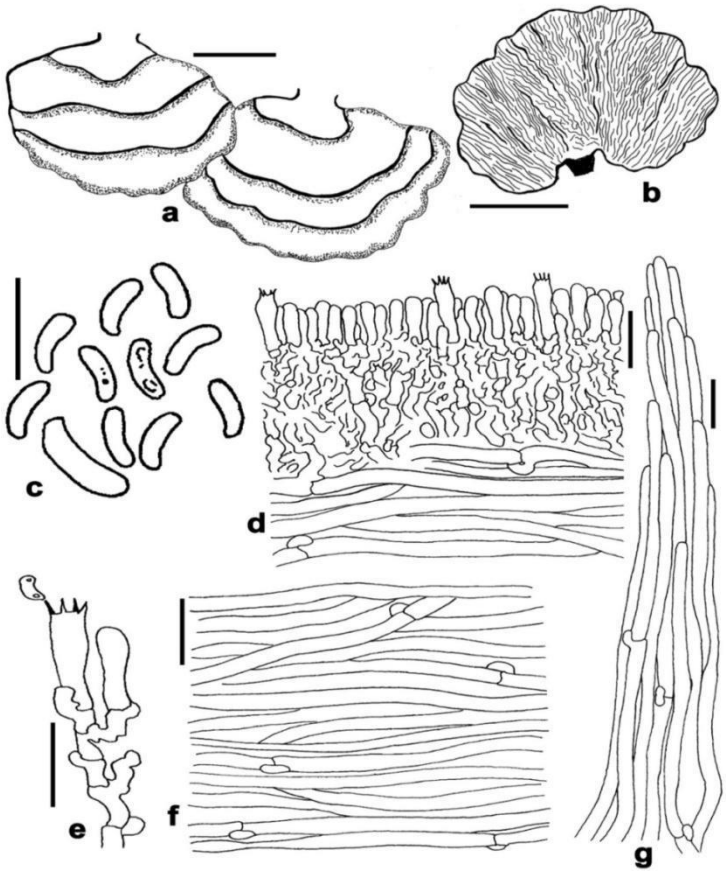


Fig. 94 – ***Plicaturopsis crispa***. a Basidiomata. b Basidiomata showing lamellae. c Basidiospores. d Hymenium showing basidia and hyphae. e Basidia. f Pileus hyphae showing clamp connections. g. Stipe hyphae showing clamp connections. Scale bars: a–b = 10 mm, c, e = 10 µm, d, f–g = 10 µm. Redrawn from Bernicchia & Gorjón (2010).

This fungus is widely distributed across Europe, Asia, and North America, occurring as a saprotroph on decaying broad-leaved wood, particularly *Fagus* and *Quercus* (Bernicchia et al. 2007, Dai et al. 2004, Sultana & Qureshi 2007, Jang et al. 2015, Henrici 2018, Pasailiuk 2018). Molecular phylogenetic analyses (Matheny et al. 2006, Larsson 2007, Binder et al. 2010) have confirmed the placement of *Plicaturopsis* within *Amylocorticiaceae*. These studies highlighted that *Plicaturopsis* represents an independent lineage within *Amylocorticiales.* The classification of *Plicaturopsis* in *Amylocorticiaceae*, *Amylocorticiales*, *Agaricomycetes*, *Agaricomycotina*, and *Basidiomycota* agrees in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Type species: *Plicaturopsis crispa* (Pers.) D.A. Reid

Basionym: *Cantharellus crispus* Pers.

Podoserpula D. A. Reid, Kew Bulletin 16(3), 437

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 95

Classification: *Amylocorticiaceae, Amylocorticiales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Podoserpula is also commonly known as “pagoda fungus” due to its characteristic multi-storied basidiomata (Zhou et al. 2016a). The genus was initially erected by Reid with the type species *P. pusio* (Berk.) D.A. Reid (Reid 1963). It was originally classified as *Craterellus pusio* Berk. by Berkley in 1859 based on specimens collected from Tasmania (Zhou et al. 2016a). Based on the characteristics, including basidiomata habit, basidiospores and basidia morphology, and hyphal characteristics, Reid (1963) once assigned *Podoserpula* to the family *Coniophoraceae* Ulbr. (Garnica et al. 2021). Members of this genus typically grow on decaying stumps or damp soil near live roots of native plants such as *Nothofagus dombeyi* and *N. obliqua*. They are sometimes found in association with *Pinus radiata* or *Eucalyptus* (Reid 1963, Zhou et al. 2016a). *Podoserpula* has a broad geographical distribution, occurring in China and in the Southern Hemisphere in Africa, Australia, New Zealand, and South America (Garnica et al. 2021). Currently, Species Fungorum (2026) lists six species of *Podoserpula*.

Podoserpula is characterised by its basidiomata, which feature a simple to sparingly branched axis bearing up to twelve superimposed pilei that decrease in size from top to bottom along its length (Reid 1963). The pilei are reniform to spathulate, attached to the main axis by a short, flattened, and stipe-like base. Pileus surface is glabrous and brightly coloured, while the hymenial surface is pink and densely ornamented with branched or simple folds, especially near the margin, forming a radial orientation. Additionally, warty or blister-like swellings cover the hymenium at the base of the pilei. Basidiospores are small, non-amyloid, hyaline, smooth, thick-walled, and ellipsoidal to sub-globose in shape. Basidia are clavate, 2–4 basidiospores, and possess basal clamp connections. Cystidia and gleocystidia are absent. The hyphal system is monomitic, consisting of hyaline, thin-walled, branched generative hyphae with clamp connections. Context hyphae are radially oriented, except near the hymenial folds, where separation of the hymenial layer distorts the hyphal system. The sub-hymenium layer consists of downward-growing hyphae that give rise to a non-thickened hymenium (Reid 1963).

Molecular studies utilising markers ITS, LSU, SSU, *rpb1*, and *tef-1α* suggest that *Podoserpula* is closely related to *Amyloathelia* Hjortstam & Ryvarden and *Anomoporia* Pouzar within the same family (Garnica et al. 2021). *Amyloathelia* is distinguished by its resupinate-effused, pellicular to membranaceous basidiomata and amyloid basidiospores (Hjortstam & Ryvarden 1979). Similarly, *Anomoporia* is characterised by its resupinate, poroid to slightly irpexoid basidiomata and amyloid basidiospores with acyanophilus walls (Pouzar 1966a). The classification of *Podoserpula* in *Amylocorticiaceae, Amylocorticiales, Agaricomycetidae, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* is in agreement in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Synonym: *Podoserpula* D. A. Reid

Type species: *Podoserpula pusio* (Berk.) D.A. Reid
Basionym: *Craterellus pusio* Berk
Other accepted species:
P. ailaoshanensis J.L. Zhou & B.K. Cui
P. aliweni Sand.-Leiva & Garnica
P. insignis (Cooke) J.A. Cooper
P. miranda Buyck, Duhem, Eyssart. & Ducousso
P. tristis (D.A. Reid) J.A. Cooper

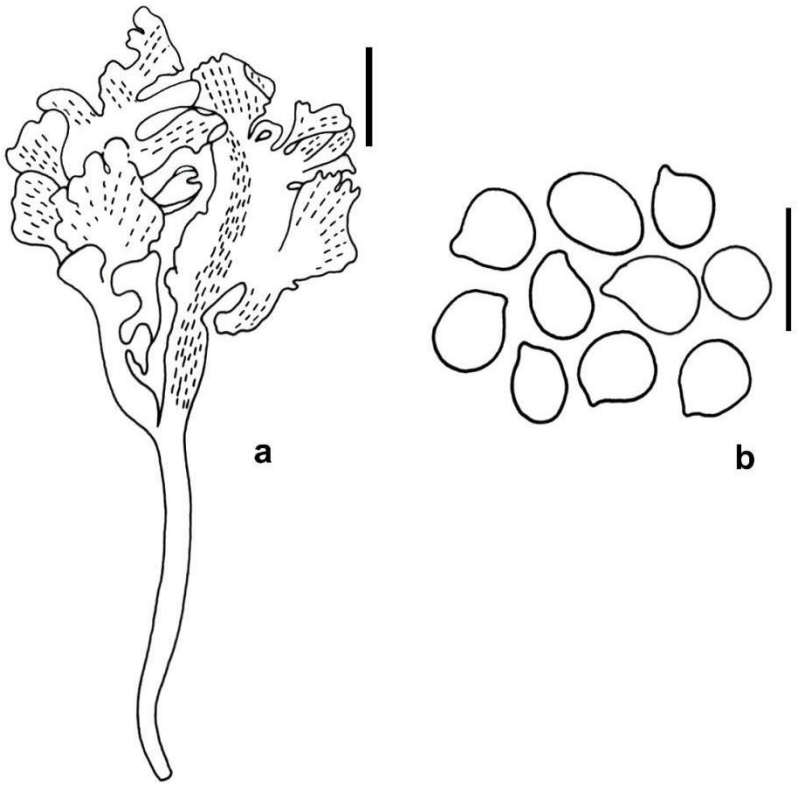


Fig. 95 – ***Podoserpula* var. *austro-americana***. a Basidiomata. b Basidiospores. Scale bars: a = 50 mm, b = 10 µm. Redrawn from Reid (1963). For original basidiomata, refer to Reid (1963).

Atheliales Jülich, Bibliotheca Mycologica 85, 343
Species Fungorum, Facesoffungi, MycoBank, GenBank

Atheliaceae Jülich, Bibliotheca Mycologica 85, 355
Species Fungorum, Facesoffungi, MycoBank, GenBank
Classification: *Atheliales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Atheliaceae was established by W. Jülich (1982) with *Athelia* Pers. as the type genus (Jülich 1982). Hyde et al. (2024a) have recognised 12 genera in this family: *Athelia*, *Athelopsis* Oberw. ex Parmasto, *Athelicium* K.H. Larss. & Hjortstam, *Athelocystis* Hjortstam & Ryvarden, *Butlerelfia* Weresub & Illman, *Elaphocephala* Pouzar, *Hypochnella* J. Schröt., *Fibulomyces* Jülich, *Hypochniciellum* Hjortstam & Ryvarden, *Melzericium* Hauerslev, *Mycostigma* Jülich, and *Taeniospora* Marvanová. *Atheliaceae* is characterised by annual, resupinate, effused, loosely adnate, and pellicular basidiomata, with an undifferentiated margin, smooth hymenium, subglobose to elliptic or fusoid, thin-walled, hyaline, and smooth basidiospores, monomitic hyphal system, and without cystidia (Sulistyo et al. 2021). Members of the family are distributed worldwide and are mainly saprotrophic, while a few species are parasitic on plants or lichens (Sulistyo et al. 2021).

Butlerelfia Weresub & Illman, Canadian Journal of Botany 58(2), 144

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 96

Classification: *Atheliaceae, Atheliales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Butlerelfia, a monotypic genus, was established by L.K. Weresub and W.I. Illman in 1980, with its type species *B. eustacei* (Weresub & Illman 1980, Hyde et al. 2024a). The species was named in honour of H.J. Eustace and L.F. Butler, who first described the species (Weresub & Illman 1980). Initially, this species was classified as *Corticium centrifugum* sensu Butler, a name now considered inapplicable (Weresub & Illman 1980). *Butlerelfia* species are distributed in North America and Europe (Wenneker et al. 2017, He et al. 2019).

Butlerelfia is characterised by broadly effused basidiomata that are smooth, white to creamy, and turn tan with maturity (Weresub & Illman 1980). The context is prosenchymatous and somewhat ceraceaous, while the hymenium is homogeneous. Basidiospores are ellipsoid to ovoid or somewhat oblong. Basidia are long, evenly clavate, and possess four sterigmata. In culture, the mycelium of *B. eustacei* grows rapidly, initially white and floccose, then becoming farinose with fertile granules, and producing delicate athelioid membranes during fruiting. Notably, hypha branching is typically interseptal rather than originating from the clamp cells (Weresub & Illman 1980).

The type species, *Butlerelfia eustacei,* is known to cause “fish-eye rot disease” in apples and pears in cold storage, as well as “fig black necrosis” in fig orchards (Weresub & Illman 1980, Sholberg & Haag 1996, Negahban et al. 2024). Recently, Negahban et al. (2024) used morphological characteristics and phylogenetic analyses (ITS, LSU, and *rpb2*) to delineate this species from other closely related genera. Additionally, pathogenicity on detached shoots and one-year-old saplings of fig cultivars revealed that *B. eustacei* causes brown lesions and wood discolouration (Negahban et al. 2024). The classification of *Butlerelfia* in *Atheliaceae, Atheliales, Agaricomycetes, Agaricomycotina,* and *Basidiomycota* agrees in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Type species: *Butlerelfia eustacei* Weresub & Illman

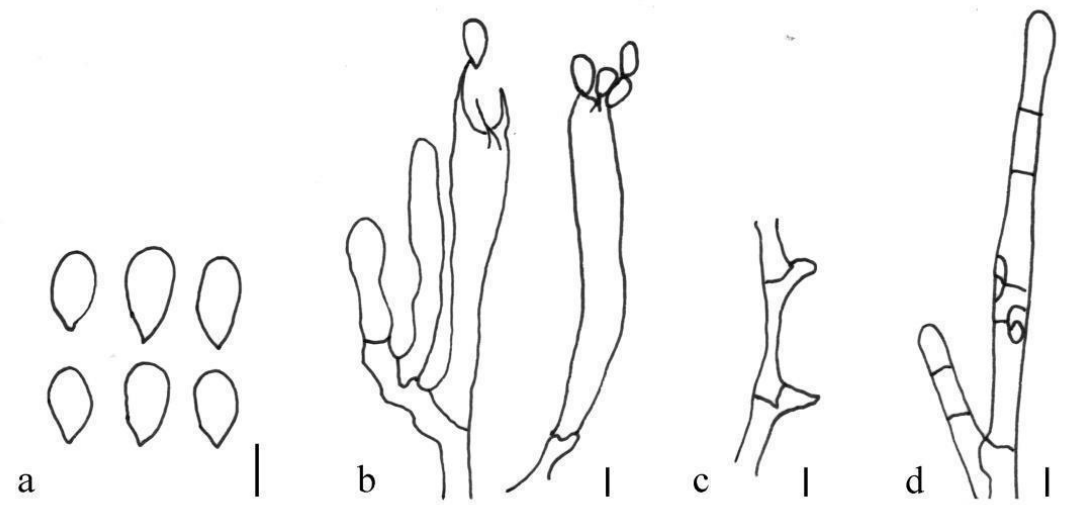


Fig. 96 – ***Butlerelfia eustacei***. a Basidiospores. b Basidia with attached basidiospores. c–d Branching from clamped cells. Scale bar: a–d = 10 µm. Redrawn from Weresub & Illman (1980). For original basidiomata, refer to Weresub & Illman (1980).

Melzericium Hauerslev, Friesia 10(4–5), 316

Species Fungorum, Facesoffungi, MycoBank Fig. 97

Classification: *Atheliaceae, Atheliales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

The corticioid genus *Melzericium* was established by K. Hauerslev, with its type species *M. udicola,* described based on a specimen collected in Sweden (Jülich 1976). *Melzericium* species are widespread (especially in Europe, North America, and Asia) and saprobic in nature (Ghobad-Nejhad et al. 2008). Morphologically, the basidiomata of *Melzericium* are resupinate, effused, membranous, adnate, and separable into small pieces (Jülich 1976). The hymenial surface is cream-colored, smooth, and typically not cracked when dried, with a margin that is colourless or whitish, indeterminate, and thinning out (Jülich 1976). The hyphal system is monomitic, featuring hyaline, thin-walled, smooth, and clamped hyphae (Jülich 1976, Maekawa & Norden 2002). Basidiospores are hyaline, thin-walled, amyloid, indextrinoid, cyanophilous, and smooth with a distinct apiculus. Basidia are stalked, hyaline, smooth, thin-walled, clamped at the base, with four sterigmata, and flexuous-cylindrical when young, becoming clavate upon maturity (Jülich 1976). Cystidia are absent (Jülich 1976, Maekawa & Norden 2002).

Species identification within *Melzericium* is based solely on morphological characteristics, as no molecular evidence has been reported (He et al. 2019). The genus includes three accepted species: *M. bourdotii* is characterised by distinctly constricted spores in the middle, *M. udicola* by bean- or kidney-shaped spores, and *M. rimosum* by cylindrical to suballantoid spores, often with a suprahilar depression (Jülich 1976, Ghobad-Nejhad et al. 2008, He et al. 2019). The classification of *Melzericium* in Species Fungorum, MycoBank and Hyde et al. (2024a) is under *Atheliaceae*, whereas UNITE lists it under *incertae sedis* and may need updating.

Type species: *Melzericium udicola* (Bourdot) Hauerslev

Basionym: *Corticium udicola* Bourdot

Other accepted species:

M. bourdotii Jülich

M. rimosum Bononi & Hjortstam

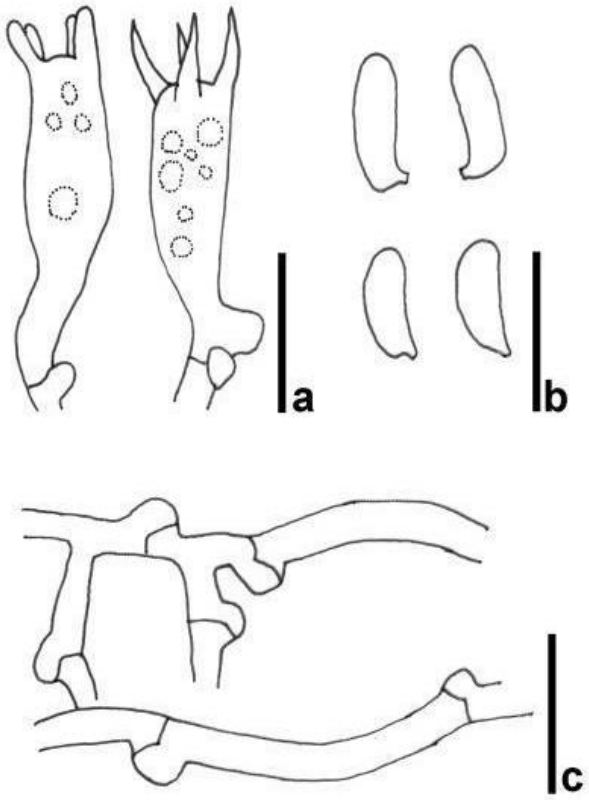


Fig. 97 – ***Melzericium rimosum*** (TMI25484). a Basidia. b Basidiospores. c Subicular hyphae. Scale bar: a–c = 10 µm. Redrawn from Maekawa & Norden (2002).

Boletales E.-J. Gilbert, Les Livres du Mycologue, Tome III: Les Bolets, 83 (1931)
Species Fungorum, Facesoffungi, MycoBank, GenBank

Boletaceae Chevall., Flore Générale des Environs de Paris 1, 248
Species Fungorum, Facesoffungi, MycoBank, GenBank
Classification: *Boletales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Boletaceae is the largest and most diverse family in *Boletales* E.J. Gilbert, established by F.F. Chevallier in 1826, with *Boletus* L. as its type genus (Chevallier 1826, Wang et al. 2023). *Boletaceae* are distributed worldwide and are ectomycorrhizal mushroom-forming fungi (Tremble et al. 2024). *Boletaceae* is characterised by large, fleshy, and brilliantly coloured basidiomata, with tubulose, lamellate, or loculus hymenophore (Wang et al. 2023). Hyde et al. (2024a) reported 115 genera in this family. Some species of this family are wild-collected edible mushrooms (Dentinger & Suz 2014, Tremble et al. 2024).

Buchwaldoboletus Pilát, Friesia 9(1–2), 217
Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 98
Classification: *Boletaceae, Boletales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Buchwaldoboletus was established by A. Pilát in 1969, with its type species *B. lignicola* (Pilát 1969). This species was first described by Franz Joseph Kallenbach in 1929 as *Boletus lignicola*, based on specimens collected from soil near conifer trunks in Germany (Pilát 1969). Species of *Buchwaldoboletus* are non-mycorrhizal, saprophytic, and lignicolous (Ortíz-Santana & Both 2011). However, the type species *B. lignicola* is mycoparasitic on the wood decay fungus *Phaeolus schweinitzii* (Fr.) Pat. (Caiafa & Smith 2022). Notably, *Buchwaldoboletus* species exhibit dual trophic modes as saprobes and mycoparasites (Caiafa & Smith 2022). Although members of *Buchwaldoboletus* are distributed worldwide, *B. lignicola* is a rare species (Ortíz-Santana & Both 2011, Blanco-Dios 2013, Jo et al. 2019).

Buchwaldoboletus is characterised by a decurrent and aruate hymenophore, bluing, yellow flesh, and basal mycelium (Pilát 1969). Basidiomata lack a clamp connection, although they are present in the hyphae of cultures (Pilát 1969, Watling 2008). Caiafa and Smith (2022) demonstrated that *Buchwaldoboletus* is polyphyletic. Watling & Hills (2005) proposed two lineages within *Buchwaldoboletus,* namely, *Lignicola* and *Sphaerocephalus*. Later, Ortíz-Santana and Both (2011) added a third lineage, *Hemichrysus*. *Lignicola* lineages are characterised by a tomentose pileus and stipe with shades of brown or reddish brown, dry, yellow context, and bluing, especially above the tubes (Ortíz-Santana & Both 2011, Blanco-Dios 2013). The *Sphaerocephalus* group features a yellow pileus and stipe, a silky tomentose pileus that is viscid when wet, context bluing, and habitat on pine sawdust, often in enclosed areas (Ortíz-Santana & Both 2011, Blanco-Dios 2013). *Hemichrysus* group has a bright yellow pileus and stipe, pulverulent appearance, a yellow pore surface that becomes subferrugineous, and a yellow stipe above, reddish below (Ortíz-Santana & Both 2011, Blanco-Dios 2013).

Qin et al. (2024) used morphological and phylogenetic analyses (LSU, *tef-1α*, and *rpb2*) to delineate *Buchwaldoboletus* from other closely related genera. Phylogenetically, *Buchwaldoboletus* is closely related to *Chalciporus* Bataille and *Pseudophylloporus* N.K. Zeng, H.Z. Qin, W.F. Lin & L.G. Hu (Qin et al. 2024). However, *Chalciporus* has a pinkish-red to reddish-brown pileal surface, and its context does not turn bluish when injured (Qin et al. 2024). Additionally, *Pseudophylloporus* has a nearly smooth pileal surface and a lamellate hymenophore (Qin et al. 2024). Species Fungorum (2026) lists ten species worldwide of *Buchwaldoboletus*. The classification of *Buchwaldoboletus* in Species Fungorum, GenBank, MycoBank, and Hyde et al. (2024a) is under *Boletaceae*, whereas UNITE lists it under *incertae sedis* and may need updating.

Type species: *Buchwaldoboletus lignicola* (Kallenb.) Pilát
Basionym: *Boletus lignicola* Kallenb.
Other accepted species: (Species Fungorum – search *Buchwaldoboletus*)

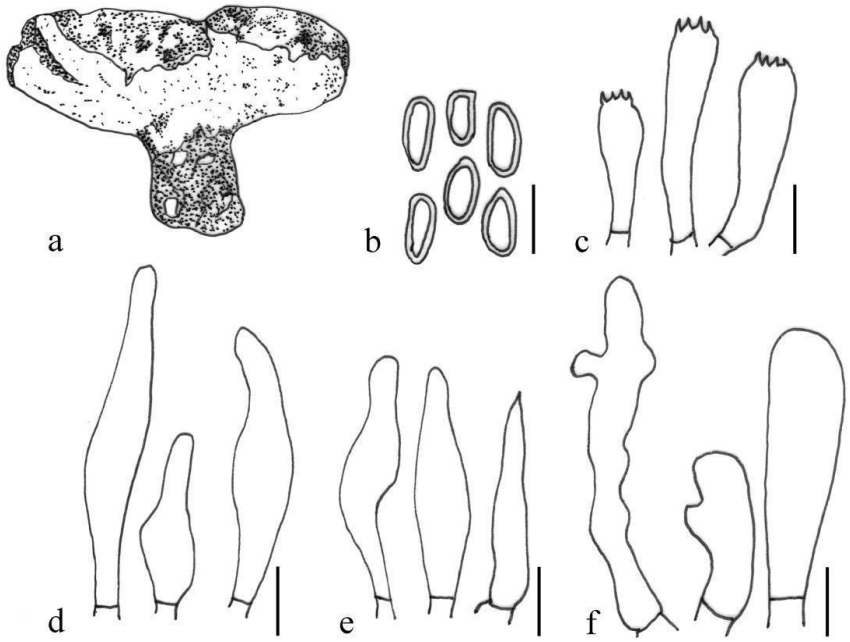


Fig. 98 – ***Buchwaldoboletus pontevedrensis*** (holotype). a Basidiomata. b Basidiospores. c Basidia. d Cystidia. e Caulocystidia. f End cells of peleipellis. Scale bar: b–f = 10 µm. Redrawn from Blanco-Dios (2013). For original basidiomata, refer to Blanco-Dios (2013).

Chalciporus Bataille, Bulletin de la Société d'Histoire Naturelle du Doubs 15, 39

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 99

Classification: *Boletaceae, Boletales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Chalciporus was established by F. Bataille in 1908, with *C. piperatus* (Bataille 1908) as its type species. Initially, this species was classified as *Boletus piperatus* Bull. based on specimens collected in France (Bulliard 1790). The genus diverged early in the evolutionary history of the *Boletaceae* (Nuhn et al. 2013, Xu et al. 2021). *Chalciporus* species form an ectomycorrhizal association with a wide range of hosts, including *Pinus*, *Fagus*, *Quercus*, *Betula*, *Nothofagus*, *Cistus*, and *Abies* (Singer 1986, Degreef & Kesel 2008, Ayala-Vásquez et al. 2023). Nuhn et al. (2013) reported that the type species also exhibits mycoparasitic behaviour, colonising *Amanita muscaria* (L.) Lam. (Dickie et al. 2010, 2016). Members of *Chalciporus* are distributed worldwide (Degreef & Kesel 2008, Klofac & Krisai-Greilhuber 2021, Ayala-Vásquez et al. 2023).

Chalciporus is characterised by small to medium-sized basidiomata with a pinkish-red to reddish-brown pileus and a pileipellis composed of trichoderm (Ayala-Vásquez et al. 2023). The hymenophore is adnate to sub-decurrent, with colours ranging from reddish-brown to salmon, yellow, or chrome, which remains unchanged or slowly turns bluish to dull blue when cut (Ayala-Vásquez et al. 2023). The stipe is solid, with its base covered in yellow mycelium, and it lacks velar remnants on both the cap and stipe (Degreef & Kesel 2008). Basidiospores are smooth-walled and either elongate or short ellipsoid (Degreef & Kesel 2008, Xu et al. 2021). Cystidia are typically conspicuous, while hyphae lack clamp connections (Singer 1986, Degreef & Kesel 2008). The taste of *Chalciporus* is either mild or acrid peppery (Singer 1986).

Phylogenetically, *Chalciporus* is the most closely related to the monotypic genus *Buchwaldoboletus* Pilát (Nuhn et al. 2013). However, the latter differs in having a decurrent to arcuate hymenophore, bluing and yellow flesh (Singer 1986). Additionally, members of *Buchwaldoboletus* lack clamp connections in basidiomata, though these are present in hyphae of cultures (Singer 1986, Watling 2008, Nuhn et al. 2013).The classification of *Chalciporus* in Species Fungorum, MycoBank, GenBank, and Hyde et al. (2024a) is under *Boletaceae*, whereas UNITE lists it under *incertae sedis* and may need updating.

Ayala-Vásquez et al. (2023) described two new species, *C. perezsilvae* and *C. piedracanteadensis,* using morphological characteristics and phylogenetic analyses (ITS, LSU, *rpb2*, and *tef-1α*). Nanu and Kumar (2024) described a new species, *C. rubrostipitatus,* based on morphological and molecular analyses (ITS, LSU, and *rpb2*). Several metabolites have been characterised from species of *Chalciporus*, including sclerocitrin, variegaic acid, variegatorubin, chalcitrin, and *2H*-azepine derivative chalcoporone (Xu et al. 2021). The type species is believed to be edible and has been used for dyeing (Li & Song 2002, Roberts & Evans 2011). Currently, Species Fungorum (2026) lists 37 species of *Chalciporus*.

Synonymy: *Chalciporus* subgen. *Rubinoboletus* (Pilát & Dermek) Klofac & Krisai, *Rubinoboletus* Pilát & Dermek

Type species: *Chalciporus piperatus* (Bull.) Bataille

Other accepted species: (Species Fungorum – search *Chalciporus*)

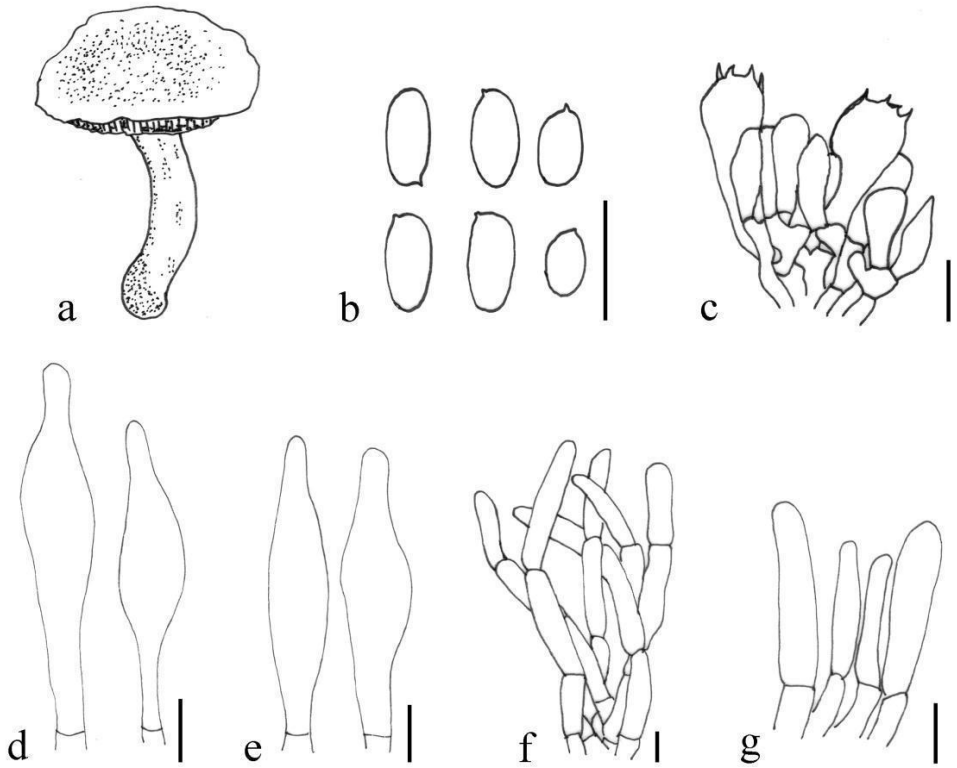


Fig. 99 – ***Chalciporus vulparius*** (FHMU5560, holotype). a Basidiomata. b Basidiospores. c Basidia and basidioles. d Cheilocystidia. e Pleurocystidia. f Pileipellis. g Stipitipellis. Scale bar: b–g = 10 µm. Redrawn from Xu et al. (2021). For original basidiomata, refer to Xu et al. (2021).

Chamonixia Rolland, Bulletin de la Société Mycologique de France 15, 76

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 100

Classification: *Boletaceae, Boletales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Chamonixia was established by L. Rolland in 1899, with *C. caespitosa* Rolland from France designated as the type species (Mleczko et al. 2009, Orihara et al. 2016). This fungus is one of the sequestrated descendants of epigeous boletes (Orihara et al. 2016). The species of *Chamonixia* are characterised by gasteroid, spongy, white, fibrillose basidiomata, which often turn blue when bruised. The hymenophore is loculate, with small, round to oval chambers that are initially pale, then brown, and lack a stipe (Rolland 1899, Mleczko et al. 2009, Orihara et al. 2016). Basidia are mostly 4-spored and elliptic, brown, with 6–12 large, blunt, and longitudinal irregular ridges of basidiospores (Lebel et al. 2012, Orihara et al. 2016). The species of *Chamonixia* has four

developmental steps identical to those of *Suillus* and *Boletinus*, and basidiomata are exocarpic, claustropileate, and amphicleistoblemate (Clémençon 2005a, Mleczko et al. 2009).

Chamonixia is polyphyletic with *Chamonixia s. s.* from Europe and North America, and the remaining species found in Australasia, Japan, and China were transferred into another genus, *Rossbeevera* T. Lebel & Orihara (Lebel et al. 2012, Orihara et al. 2016). Hyde et al. (2024a) have recognised four species worldwide. Lebel et al. (2012) conducted morphological and phylogenetic analyses (ITS and LSU) of species of *Chamonixia* and found affinities with *Leccinum* and *Leccinellum*. Orihara et al. (2016) used morphology and phylogenetic analysis (ITS) to distinguish species of *Chamonixia*. The type species, *C. caespitosa*, is often considered rare and listed as endangered in the USA and many European countries (Mleczko et al. 2009, Orihara et al. 2016). The classification of *Chamonixia* in *Boletaceae, Boletales, Agaricomycetes, Agaricomycotina,* and *Basidiomycota* agrees in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Type species: *Chamonixia caespitosa* Rolland

Other accepted species:

C. albida (Massee & Rodway) Y.S. Chang & Kantvilas

C. brevicolumna A.H. Sm. & Singer

C. caudata (Zeller & C.W. Dodge) A.H. Sm. & Singer

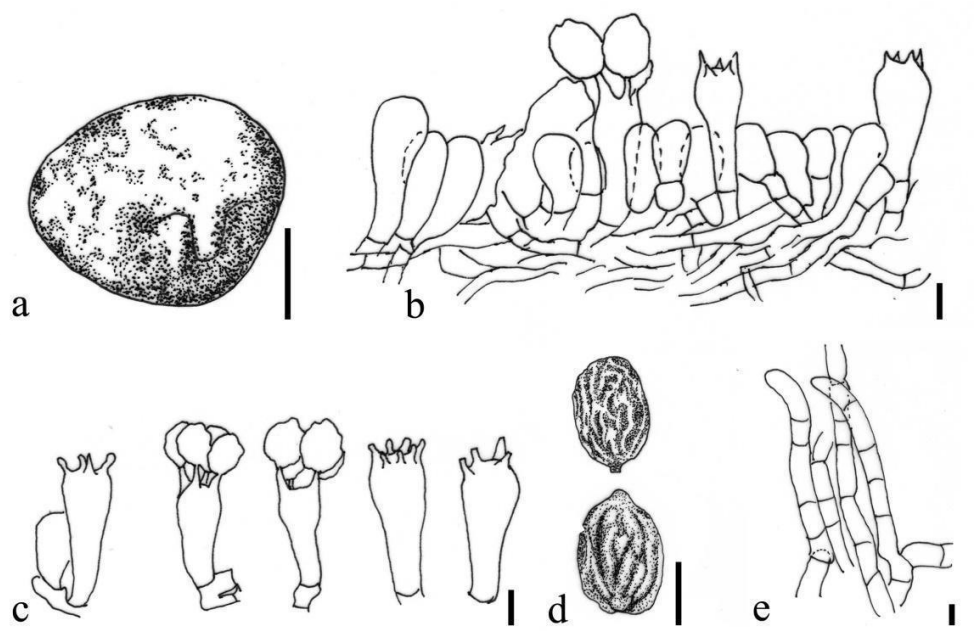


Fig. 100 – ***Chamonixia caespitosa***. a Basidiomata. b Section through hymenium and subhymenium with basidia, and sterile elements. c Basidia. d Basidiospores. e Hyphae on the peridium surface. Scale bar: a = 1 cm, b–e = 10 µm. Redrawn from Mleczko et al. (2009).

Gastroboletus Lohwag, Beihefte zum Botanischen Centralblatt, Abteilung 2, 42(2), 273

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 101

Classification: *Boletaceae, Boletales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Gastroboletus was established by Heinrich Lohwag in 1926 based on specimens collected from the ground in China (Lohwag 1926). In 1937, Lohwag further described the specimen and classified it as *G. boedijnii*, which became the type species of the genus (Lohwag 1937). *Gastroboletus* is readily distinguished by its hymenophore, which, although distinctly tubulose, is developed to preclude deposition of spores. The 'tubes' are often not vertically oriented and may be covered by a well-developed, persistent peridial membrane or blocked by outgrowths of wall tissue.

Spore deposits have never been observed from any of these fungi on either the adjacent substrate or on the inner surface of the peridial membrane (Lohwag 1926, Lohwag 1937, Smith & Singer 1959). *Gastroboletus* has been reported from North and South America, Asia, South Africa, Western Europe, and eastern Australia (Lohwag 1926, Zang 1995, Smith & Singer 1959, Singer & Smith 1964, Thiers & Trappe 1969, Horak 1977, Thiers 1979, Cázares & Trappe 1991, Nouhra & Castellano 1995, Trappe & Castellano 2000, Nouhra et al. 2002). Species of *Gastroboletus* have significant ecological value, but there have been no reports of their medicinal or edible uses. Hyde et al. (2024a) recognised 13 species worldwide. Nouhra et al. (2002) provided a comprehensive key to all known species of *Gastroboletus*. The classification of *Gastroboletus* in *Boletaceae, Boletales, Agaricomycetes, Agaricomycotina,* and *Basidiomycota* agrees in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Type species: *Gastroboletus boedijnii* Lohwag

Other accepted species: (Species Fungorum – search *Gastroboletus*)

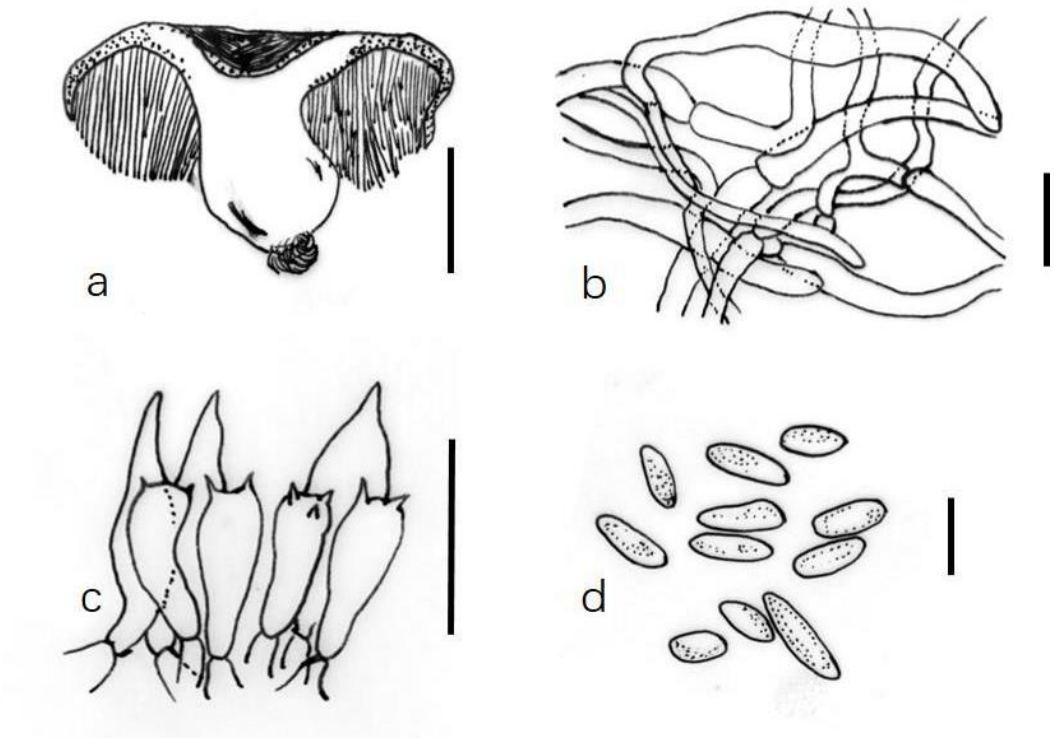


Fig. 101 – ***Gastroboletus turbinatus***. a. Basidiomata section. b. Peridium hyphae. c. Basidia and cystidia. d. Basidiospore. Scale bars: a = 1 cm, b = 10 µm, c = 20 µm, d. = 10 µm. Redrawn from Smith & Singer (1959), Nouhra et al. (2002).

Gymnogaster J.W. Cribb, Papers from the Department of Botany (formerly Biology) University of Queensland 3, 109

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 102

Classification: *Boletaceae, Boletales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Gymnogaster, a monotypic genus, was established by J.W. Cribb in 1956 with its type species, *G. boletiodes* (Cribb 1956, Hyde et al. 2024a). This species was described from specimens collected on wood in Queensland, Australia (Cribb 1956). *Gymnogaster* is an emergent truffle-like fungus growing gregariously and forming mycorrhizal associations with *Eucalyptus*, *Lophostemon*, and *Corymbia* (Bougher & Barrett 2020). This genus is endemic to Australia (Cribb 1956, Halling et al. 2012, Bougher & Barrett 2020). The taxonomic placement of *G. boletiodes* was uncertain for a long time, with it being placed in either *Secotiaceae* Tul. & C. Tul. or *Agaricaceae* Chevall.

(Cribb 1956, Kirk et al. 2008). However, through phylogenetic analyses, Halling et al. (2012) demonstrated that *Gymnogaster* belongs to *Boletaceae* (Zhao et al. 2014, Smith et al. 2015). The classification of *Gymnogaster* in Species Fungorum, GenBank, UNITE, and Hyde et al. (2024a) is under *Boletaceae*, whereas MycoBank lists it under *Agaricaceae* and may need updating.

Gymnogaster is characterised by its bright lemon-yellow basidiomata, ovoid, subglobose to elongate, or irregular shape (Cribb 1956, Gelardi et al. 2017). The pileus features a small, apical, appressed disc that is depressed and occasionally absent. The hymenophore is permanently exposed, moderately fleshy, and composed of labyrinthine to irregularly folded chambers (Gelardi et al. 2017). The stipe is central, straight, and cylindrical, and extends into the hymenophore as a columella. It is bright yellow internally and externally, bruising blue and later turning dark brown (Cribb 1956, Gelardi et al. 2017). The apex of the columella is deep russet, indicating a reduced peridium (Cribb 1956). Basidiospores are symmetrical, ellipsoidal, citriform or ovate, with a prominent apiculus, inamyloid, and acyanophilic (Gelardi et al. 2017). Basidia are cylindrical-clavate to clavate and 4-spored (Cribb 1956). The odour ranges from faint to occasionally pungent. Cheilocystidia are abundant, straight to flexuous, variably shaped, irregularly cylindrical, smooth, moderately thick-walled, and have rounded to subacute tips. Pleurocystidia are uncommon, and clamp connections are absent in all tissues (Gelardi et al. 2017).

Halling et al. (2012) utilised morphological characteristics and phylogenetic analyses (LSU and *tef-1α*) to delineate this genus from closely related genera. Morphologically, *Gymnogaster* resembles *Secotium* Kunze, but is distinct from *Secotium* in the absence of a peridium (Cribb 1956). Additionally, *G. boletoides* also resembles *Neoboletus thibetanus* (Shu R. Wang & Yu Li) Zhu L. Yang, B. Feng & G. Wu (Wu et al. 2016a, Gelardi et al. 2017). However, the latter species lacks apical peridial remnants (Gelardi et al. 2017).

Type species: *Gymnogaster boletoides* J.W. Cribb

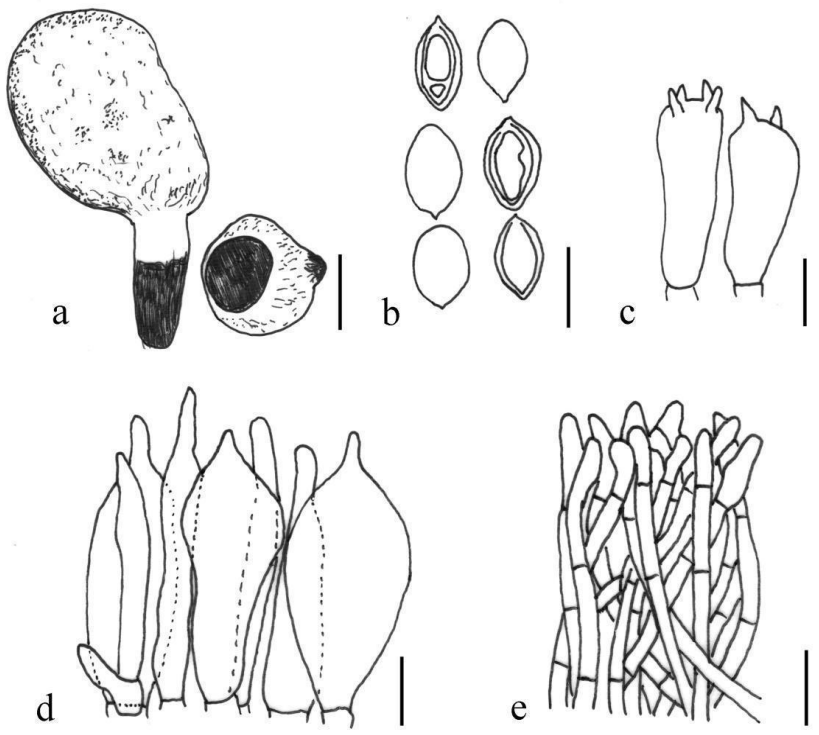


Fig. 102 – ***Gymnogaster boletoides*** (Halling 9455, BRI). a Basidiomata. b Basidiospores. c Basidia. d Cheilocystidia and Pleurocystidia. e Pileipellis. Scale bar: a = 1 cm, b–d = 10 µm, e = 20 µm. Redrawn from Gelardi et al. (2017). For original basidiomata, refer to Gelardi et al. (2017).

Leccinum Gray, A Natural Arrangement of British Plants (London) 1, 646

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 103

Classification: *Boletaceae*, *Boletales*, *Agaricomycetes*, *Agaricomycotina*, *Basidiomycota*, *Fungi*

Leccinum was first described by Samuel Frederick Gray in 1821 (Gray 1821). The name *Leccinum* derives from the Italian "leccino" (Gray 1821); members of this genus are commonly known as "scaber stalks" due to the scaly or scabrous stipe surface (Meng et al. 2021). Molecular phylogenetic studies have confirmed *Leccinum* as a distinct genus within *Boletaceae* (Meng et al. 2021). It is characterised by its distinctive scabrous (rough-scaly) stipe and sponge-like pores instead of gills, often associated with mycorrhizal relationships with trees (Gray 1821, Meng et al. 2021). Species form obligate ectomycorrhizal associations primarily with *Betula* (birch), *Populus* (aspen), and *Quercus* (oak). The genus has a holarctic distribution, with diversity hotspots in boreal forests and temperate regions (Halling et al. 2012).

Leccinum species produce basidiomata with dry, often cracked pilei ranging from reddish-brown to orange or grey (Meng et al. 2021). *Leccinum* are typically medium to large, with a convex to flat cap and a stout, scaly stipe, and the stipe surface features prominent scabers (Meng et al. 2021). The pileus surface is often dry and can range in colour from brown to orange or red (Meng et al. 2021). The pore surface is white to cream, turning darker with age (Smith & Thiers 1971, Meng et al. 2021). They have elongated, fusiform basidiospores and a trichodermium-type pileipellis (Lannoy & Estadès 1995).

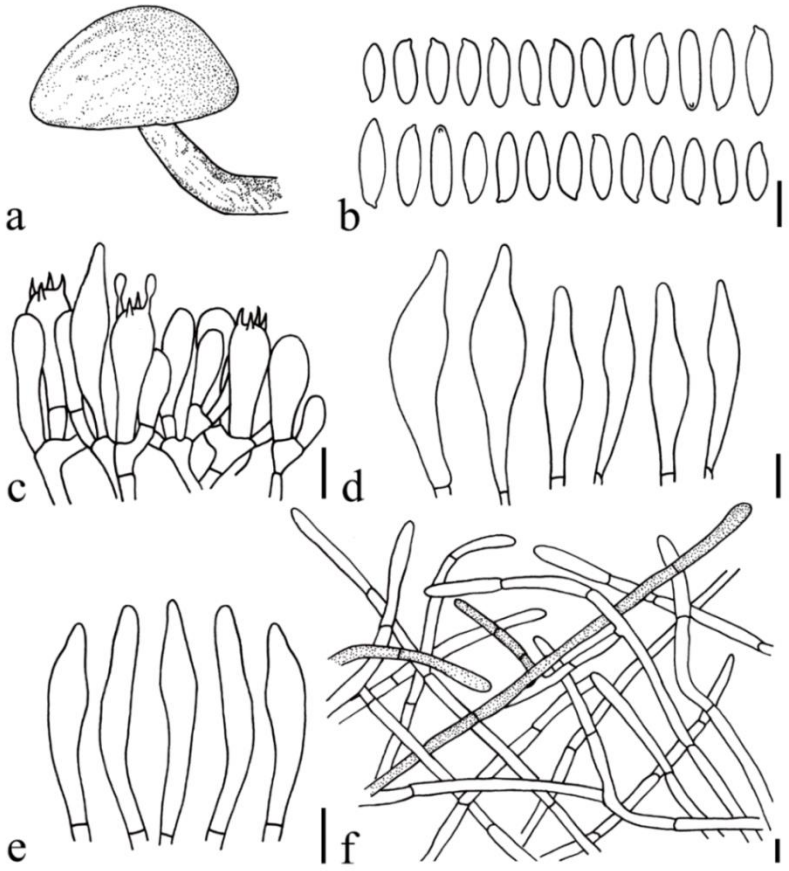


Fig. 103 – ***Leccinum pseudoborneense*** (KUN-HKAS110156, holotype). a Basidiomata. b Basidiospores. c Basidia and pleurocystidia. d Pleurocystidia. e Cheilocystidia. f Pileipellis. Scale bar: b–f = 10 µm. Redrawn from Meng et al. (2021). For original basidiomata, refer to Meng et al. (2021).

Recent multi-locus analyses using ITS, LSU, *tef*1-α, and *rpb*2 support *Leccinum* as monophyletic (Den Bakker et al. 2004). Hyde et al. (2024a) have recognised approximately 145 species of *Leccinum*. Several species are prized edibles, though all require thorough cooking to

degrade thermolabile toxins (Arora 1986). Notable species include the edible *L. aurantiacum* (Bull.) Gray (orange birch bolete) and *L. scabrum* (Bull.) Gray (brown birch bolete) (Meng et al. 2021, Gargano et al. 2025). The genus also serves as a bioindicator of forest health (Tedersoo et al. 2022).The classification of *Leccinum* in *Boletaceae, Boletales, Agaricomycetes, Agaricomycotina,* and *Basidiomycota* agrees in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Synonymy: *Krombholzia* P. Karst, *Krombholziella* Maire, *Rossbeevera* T. Lebel & Orihara, *Trachypus* Bataille

Type species: *Leccinum aurantiacum* (Bull.) Gray

Basionym: *Boletus aurantiacus* Bull.

Other accepted species: (Species Fungorum – search *Lecinum*)

Mackintoshia Pacioni & Sharp, Mycotaxon 75, 225

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 104

Classification: *Boletaceae, Boletales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Mackintoshia, a monotypic genus, was established by Giovanni Pacioni and Cathy Sharp in 2000 (Pacioni & Sharp 2000). The type species, *M. persica*, was described based on a specimen collected from sandy soil and litter under *Burkea africana* in Zimbabwe (Pacioni & Sharp 2000). *Mackintoshia*, a sequestrate fungus, forms symbiotic associations with ectomycorrhizal hosts in the family *Caesalpiniaceae* (Pacioni & Sharp 2000, Sharp & Minter 2014, Smith et al. 2015). It is a highly prized edible fungus, also known as "*Matifi*", and is consumed by both people and antelope in the Karanga region of Zimbabwe (Pacioni & Sharp 2000).

Mackintoshia is characterised by hypogeous, subglobose or subpyriform basidiomata, in which the gleba is white to pale ochraceous and turning to olivaceous at maturity (Sharp & Minter 2014). The basidiospores are smooth, dextrinoid, strongly cyanophilic, and relatively thick-walled. Basidia are hyaline, strongly cyanophilic, clavate-utriculate to utriculate, typically 4-spored, sometimes 2-spored, and often arise from a short cylindrical basal cell or directly from a branched element. Cystidia are clavate to cylindrical, thin-walled, and contain cyanophilic content, while tramal hyphae are broad, hyaline, and loosely interwoven. Clamp connections are absent. This fungus is distinguished by its mild flavour and a distinct fruity aroma, reminiscent of ripe peaches (Sharp & Minter 2014).

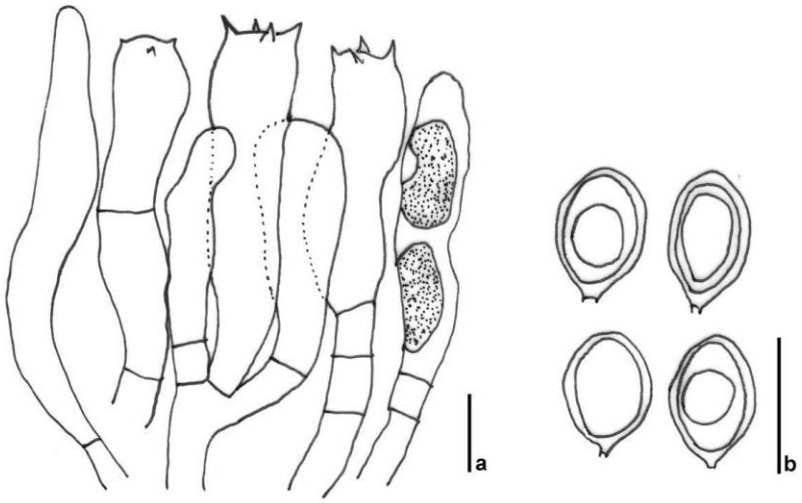


Fig. 104 – ***Mackintoshia persica***. a Section of the hymenium layer. b Basidiospores. Scale bar: a–b = 10 μm. Redrawn from Pacioni & Sharp (2000).

Mackintoshia shares basidiospore characteristics with *Galerina* Earle; however, its basidiospores are statismosporic and lack a noticeable reduction in wall thickness at the apex corresponding to a germ pore area (Pacioni & Sharp 2000). Phylogenetically, *Mackintoshia* is closely related to *Mycoamaranthus* Castellano, Trappe & Malajczuk; however, the latter differs in having gleba without a columella, a basal pad, spiny mature basidiospores, and the absence of cystidia (Pacioni & Sharp 2000).

In 2015, Smith et al. used morphological characteristics and phylogenetic analyses (ITS and LSU) to show that *Mackintoshia persica* and *Jimtrappea guyanensis* T.W. Henkel, M.E. Sm. & Aime belong to the same clade; however, their relationship has low bootstrap support and significant divergence (Smith et al. 2015). The classification of *Mackintoshia* in Species Fungorum, GenBank, UNITE, and Hyde et al. (2024a) is under *Boletaceae*, whereas MycoBank lists it under *Cortinariaceae* and may need updating.

Type species: *Mackintoshia persica* Pacioni & Sharp

Paxillogaster E. Horak, in Horak & Moser, Nova Hedwigia 10(3/4), 332

Species Fungorum, Facesoffungi, MycoBank

Classification: *Boletaceae, Boletales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Paxillogaster is a monotypic gasterioid genus established by E. Horak and M. Moser in 1966 (Horak & Moser 1966, Hyde et al. 2024a). Its type species, *P. luteus*, was described from specimens collected on the ground under *Nothofagus dombeyi* in Rio Negro, South America (Horak & Moser 1966). *Paxillogaster* forms ectomycorrhizal associations with plants and is found in South America, including Argentina (Pegler & Young 1981, Nedelin 2014).

Paxillogaster is characterised by its epigeal, stipitate basidiomata with a sub-lamellate gleba that is partially or permanently enclosed. Basidiospores are cylindric, asymmetric, and yellowish, with a suprahilar applanation, a broadly rounded apex, and a uniformly rugulose surface. The hyphae lack clamp connections (Pegler & Young 1981).

Species delineation of *Paxillogaster* from other genera is based solely on macro- and micromorphology due to the lack of molecular sequences (He et al. 2019). *Paxillogaster* is closely related to *Xerocomaceae* Pegler & T.W.K. Young by its elongated, yellowish basidiospores and the absence of clamp connections (Pegler & Young 1981). The classification of *Paxillogaster* in *Boletaceae, Boletales, Agaricomycetes, Agaricomycotina,* and *Basidiomycota* agrees in Species Fungorum, MycoBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Type species: *Paxillogaster luteus* E. Horak

Phylloboletellus Singer, in Singer & Digilio, Lilloa 25, 438

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 105

Classification: *Boletaceae, Boletales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Phylloboletellus is a monotypic genus established by R. Singer and A.P.L. Digilio in 1951 (Singer & Digilio 1951, Nuhn et al. 2013). Its type species, *P. chloephorus*, was described from specimens collected in subtropical or tropical montane forests on soil in Tucuman, Argentina (Singer & Digilio 1951, Bandala et al. 2004). *Phylloboletellus* is ectomycorrhizal and exhibits partial parasitic behaviour (Singer 1981b, Bandala et al. 2004, Nuhn et al. 2013). This genus is found across Central and South America, including Argentina, Bolivia, and Mexico (Zhang & Li 2018, He et al. 2019).

Phylloboletellus is characterised by its stipitate-pileate basidiomata, with acute, incurved pileus margins that are glabrous and vary in colour from yellow-orange to orange-reddish or brown. Lamellae are decurrent and somewhat intervenose, yellowish-green to olive-brown, usually forked and turn blue when bruised (Singer 1962c, Qin et al. 2024). The stipe is cylindrical, with a surface covered in brownish clumps or fibrils (Bandala et al. 2004, Qin et al. 2024). *Phylloboletellus* lacks

a veil, and its context turns blue upon injury (Bandala et al. 2004, Farid et al. 2018, Qin et al. 2024). The basal mycelium is yellow (Bandala et al. 2004). Basidiospores are subglobose to short-ellipsoid with longitudinal, continuous, or bifurcate ribs (Singer 1962c, Bandala et al. 2004, Farid et al. 2018, Qin et al. 2024). Basidia are clavate, thin-walled, hyaline, clamped, and typically four-spored. Hymenial cystidia are utriform, thin-walled, and clamped. Stipitipellis are trichodermoid, composed of undifferentiated cylindrical terminal hyphae (Bandala et al. 2004). Clamp connections in hyphae are rare and generally false or incomplete (Singer 1981b). Odour is weak or pleasant, while the taste is bitter (Bandala et al. 2004).

Qin et al. (2024) utilised morphological characteristics and phylogenetic analyses (LSU) to delineate *Phylloboletellus* species from other genera. *Phylloboletellus* is closely related to *Boletellus* Murrill; however, the former is distinct by its decurrent lamellate hymenophore (Pegler & Young 1981). Additionally, *Boletellus* exhibits numerous clamp connections (Singer 1981b). The classification of *Phylloboletellus* in *Boletaceae, Boletales, Agaricomycetes, Agaricomycotina,* and *Basidiomycota* agrees in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Type species: *Phylloboletellus chloephorus* Singer

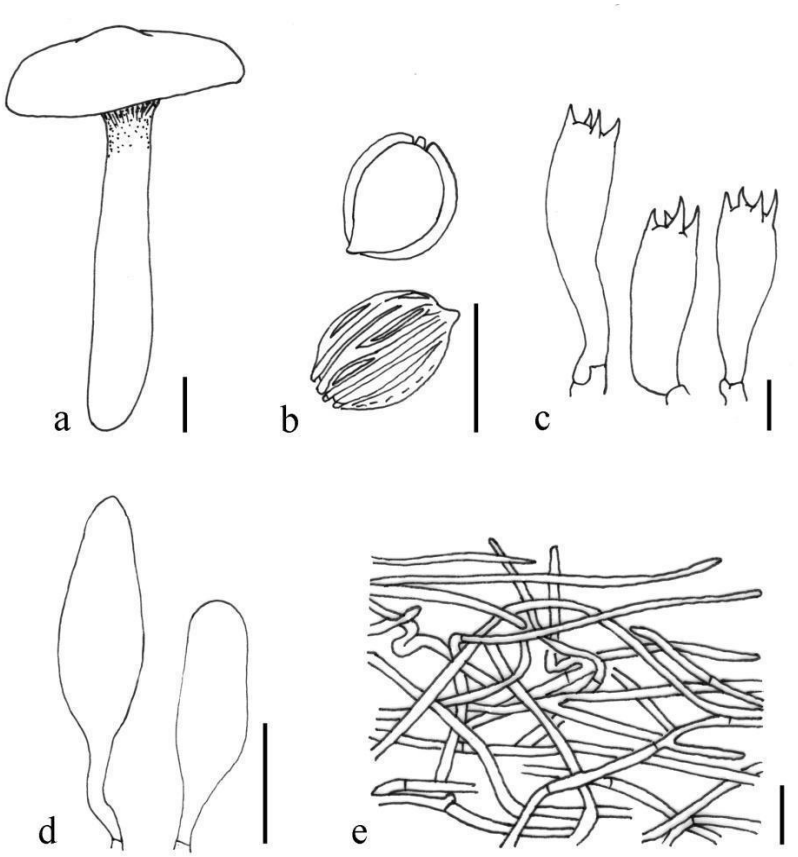


Fig. 105 – ***Phylloboletellus chloephorus*** (Bandala 3584, holotype). a Basidiomata. b Basidiospores. c Basidia. d Hymenial cystidia. e Pileipellis. Scale bar: a = 1 cm, b–d = 10 µm, e = 25 µm. Redrawn from Bandala et al. (2004). For original basidiomata, refer to GBIF (2025).

Phyllobolites Singer, Annales Mycologici 40(1/2), 59

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 106

Classification: *Boletaceae, Boletales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Phyllobolites was established by Rolf Singer in 1942 based on a specimen of *P. miniatus* collected in Surinam, Brazil. This species was initially described as *Paxillus miniatus* Rick (Singer 1964, 1986, Farid et al. 2018). Species of *Phyllobolites* are soil-dwelling, likely ectomycorrhizal,

and form associations with *Leguminosae* plants, typically growing gregariously (Singer 1981b, Farid et al. 2018). Members of *Phyllobolites* have a global distribution, including Brazil, Guyana, New Zealand, Papua New Guinea, Togo, China, Singapore, Indonesia, Colombia, and Sri Lanka (Singer 1981b, Linhares 2018). Currently, Species Fungorum (2026) lists two species of *Phyllobolites*.

The basidiomata are characterised by a red pileus, with ocher to whitish lamellae that are often forked, and a stipe with a membranous ring derived from a partial veil. The white context remains unchanged upon bruising (Singer 1964b, 1986, Zhang & Li 2018, Farid et al. 2018). The basidiospores are fusiform, verrucose, and produce an ochraceous spore print. The fungi also feature abundant pseudocystidia, and their pileipellis range from ixotrichoderm to ixocutis. Hyphae in the hymenophoral trama are subparallel to slightly divergent and exhibit gelatinisation (Singer 1964b, 1986, Farid et al. 2018).

Species within *Phyllobolites* relies entirely on macro- and micro-morphological characteristics (Singer 1981b, He et al. 2019). Morphologically, the genus is closely related to *Neopaxillus* Singer of the *Paxillaceae* Lotsy but differs in pigmentation, spore shape, and the presence of a veil and pseudocystidia (Singer 1981b). Additionally, *Phyllobolites* can be distinguished from *Paxilloboletus* Furneaux, De Kesel & F.K. Khan. by its verrucose basidiospores and the complete presence of velum on the stipe (Badou et al. 2022). Although some sequences of *Phyllobolites* are available in NCBI (2025), they have not been verified with authentic publications. A comprehensive re-description incorporating molecular data is needed to resolve its classification (Watling 2008, Farid et al. 2018). The classification of *Phyllobolites* in *Boletaceae, Boletales, Agaricomycetidae, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* is in agreement in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Type species: *Phyllobolites miniatus* (Rick) Singer

Basionym: *Paxillus miniatus* Rick

Other accepted species:

P. russuloides (Petch) Singer

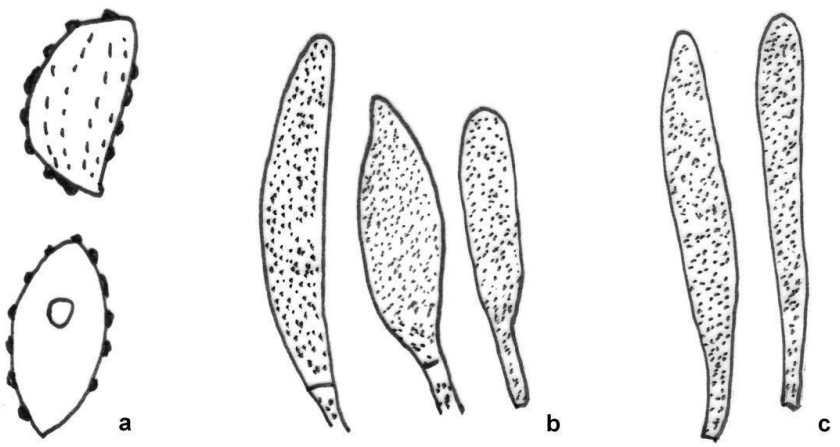


Fig. 106 – ***Phyllobolites miniatus***. a Basidiospores (×2000). b Dermatopseudocystidia (×100). c Pseudocystidia of the hymenium (×1000). Redrawn from Singer (1981b).

Phylloporus Quél., Flore mycologique de la France (Paris), 409

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 107

Classification: *Boletaceae*, *Boletales*, *Agaricomycetes*, *Agaricomycotina*, *Basidiomycota*, *Fungi*

Phylloporus was described by L. Quélet in 1888 to accommodate lamellate boletes (Quélet 1888). Unlike typical boletes with porous hymenophores, *Phylloporus* species possess decurrent lamellae, a unique feature that initially led to confusion with agarics. Molecular phylogenies later

confirmed its placement within *Boletaceae* Chevall. (Neves et al. 2012). These fungi primarily thrive in tropical and subtropical forests, forming ectomycorrhizal (ECM) associations with trees of families, *Fagaceae* (e.g., oaks, beeches) and *Dipterocarpaceae* (which are critical to Southeast Asian rainforests) (Neves et al. 2012). Members of the *Phylloporus* genus exhibit a broad global distribution, occurring across Asia (China, Japan, Thailand, Malaysia, and India), the Americas (eastern and Pacific Northwest USA, Mexico, Costa Rica, and Brazil, Africa (Cameroon and Madagascar), Oceania (Australia and Papua New Guinea), and rarely in Europe (Spain and France) (Neves et al. 2012).

Basidiomata of *Phylloporus* are stipitate with convex to plano-convex pilei, often velvety or scaly. The lamellae are yellow to golden, sometimes forked, and decurrent (Neves et al. 2012, Wu et al. 2016b). Stipe is central, dry, and lacks annuli. Basidiospores are smooth, ellipsoid to subfusoid, and the hyphal system is monomitic. A key diagnostic feature is the absence of blue bruising reactions (Neves et al. 2012, Wu et al. 2016b).

Multi-locus analyses (ITS, LSU, *tef-1α*, and *rpb2*) resolved *Phylloporus* as a monophyletic group sister to *Xerocomus* Quél. (Wu et al. 2016b). Although *Phylloporus* is closely related to *Xerocomus* based on molecular data, it differs by possessing gill-like lamellae rather than pores, unique spore morphology, distinct cap and stipe colouration, and specific ecological associations (Wu et al. 2016b). A new species, *P. montanus* E. Gutiérrez, Montoya, Ant. Ramos & A. Andrade, was described based on morphological characteristics and phylogenetic analyses (ITS, LSU, and *tef-1α*) (Bandala 2024). Hyde et al. (2024a) have recognised approximately 95 species worldwide. The classification of *Phylloporus* in *Boletaceae, Boletales, Agaricomycetidae, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* is in agreement in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

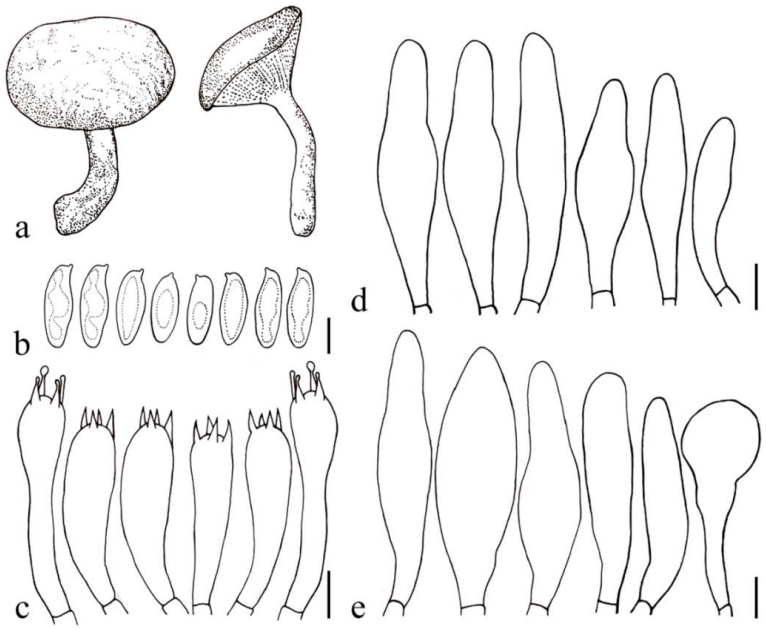


Fig. 107 – ***Phylloporus rimosus***. a Basidiomata. b Basidiospores. c Basidia. d Cheilocystidia. e Pleurocystidia. Scale bar: b = 5 µm, c–e = 10 µm. Redrawn from Montoya et al. (2019). For original basidiomata, refer to Montoya et al. (2019).

Phylloporus species provide significant ecological and economic benefits. Ecologically, they form ectomycorrhizal (ECM) associations that enhance host tree nutrient uptake, particularly phosphorus and nitrogen (Tedersoo et al. 2010), while improving drought resistance and soil structure in forest ecosystems (Smith & Read 2010). Their presence often indicates healthy, undisturbed forests, making them valuable bioindicators for conservation efforts (Lodge et al. 2004). Economically, certain species like *P. rhodoxanthus* (Schwein.) Bres. and *P. bellus* (Massee)

Corner are harvested as edible mushrooms in Asia and Central America, prized for their mild, nutty flavour and used in various culinary preparations (Montoya et al. 2019). *Phylloporus* species also show biotechnological promise, as their enzymes may assist in lignin degradation for biofuel production (Floudas et al. 2012). They also have potential applications in reforestation projects through spore inoculation to support tree growth and ecosystem restoration (Montoya et al. 2019).

Type species: *Phylloporus pelletieri* (Lév.) Quél

Basionym: *Agaricus pelletieri* Lév.

Other accepted species: (Species Fungorum – search *Phyllopours*)

Pseudoboletus Šutara, Česká Mykologie 45(1–2), 2

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 108

Classification: *Boletaceae, Boletales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Pseudoboletus was established by J. Šutara in 1991, with *P. parasiticus* (Šutara 1991) as its type species. This species was originally described as *Boletus parasiticus* Bull. from basidiomata of *Scleroderma* Pers. collected in France (Šutara 1991). *Pseudoboletus* exhibits mycoparasitic behaviour on other *Boletales*, including *Scleroderma*, *Pisolithus* Alb. & Schwein., and *Astraeus* Morgan, or it forms ectomycorrhizal associations with *Quercus* and *Pinus* species (Tedersoo et al. 2010, Nuhn et al. 2013, He et al. 2019, Cortés-Pérez et al. 2023). *Pseudoboletus* species are distributed worldwide (Cortés-Pérez et al. 2023). Notably, *P. parasiticus* has been listed as a rare and endangered fungal species in Ukraine (Heluta 2018).

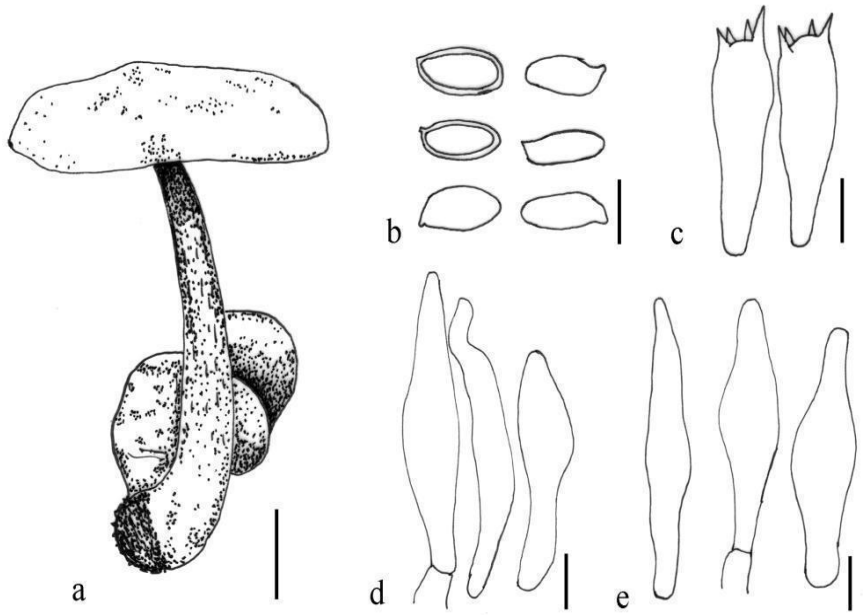


Fig. 108 – ***Pseudoboletus silvaticus*** (Cortés-Pérez 1870, holotype). a Basidiomata. b Basidiospores. c Basidia. d Pleurocystidia. e Cheilocystidia. Scale bar: a = 1.5 cm, b–e = 10 µm. Redrawn from Cortés-Pérez et al. (2023). For original basidiomata, refer to Cortés-Pérez et al. (2023).

Pseudoboletus is characterised by epigeal, pileate, centrally stipitate basidiomata with a tubulate hymenophore and is attached to *Scleroderma* or *Astraeus* Morgan (Watling 2008). Pileus is convex to semi-globate, minutely tomentose, becoming smooth with age, sometimes cracking, and exhibits a straw colour or ochraceous with a wavy margin (Watling 2008). The stipe is cylindric-curved, tapering, and concolourous with the pileus, with a sterile surface covered by a filamentous trichoderm or cutis, lacking caulobasidia (Šutara 1991, Watling 2008, Cortés-Pérez et al. 2023). Tubes are adnate to subdecurrent, initially ochraceous lemon-yellow, then ochreous to

rust-coloured (Watling 2008). Basidiospores are elongate-fusoid to cylindric, inamyloid, acyanophilic, and ornamented, which vary from reticulately venose to pitted, producing an olivaceous snuff-brown spore deposit (Watling 2008, Cortés-Pérez et al. 2023). Basidia are clavate, hyaline, thin-walled, and four-spored. Cheilocysidia and pleurocystidia are fusiform, cylindric to lageniform, with apical swelling, numerous, and hyaline. Pileipellis is a trichoderm, either hyaline or ixocutis, and clamp connections are absent (Watling 2008).

Cortés-Pérez et al. (2023) described a new species, *P. silvaticus*, based on morphological characteristics and phylogenetic analyses (ITS, LSU, and *tef-1α*). The species was collected from basidiomata of *Scleroderma nitidum* Berk., which were associated with *Quercus skinerii* (Cortés-Pérez et al. 2023). Hyde et al. (2024a) recognised only three species worldwide. The classification of *Pseudoboletus* in *Boletaceae, Boletales, Agaricomycetidae, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* is in agreement in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Type species: *Pseudoboletus parasiticus* (Bull.) Šutara

Basionym: *Boletus parasiticus* Bull.

Other accepted species:

P. astraeicola (Imazeki) Šutara

P. silvaticus Cortés-Pérez & Ram.-Cruz

Retiboletus Manfr. Binder & Bresinsky, Feddes Repertorium Specierum Novarum Regni Vegetabilis 113(1–2), 36

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 109

Classification: *Boletaceae*, *Boletales*, *Agaricomycetes*, *Agaricomycotina*, *Basidiomycota*, *Fungi*

Retiboletus was introduced by Binder & Bresinsky in 2002 (Binder & Bresinsky 2002), initially typified by *R. retipes* (Berk. & M.A. Curtis) Manfr. Binder & Bresinsky. The genus was established to accommodate species with distinct morphological and molecular characteristics, separating them from *Boletus* Tourn., and other related genera. Species of *Retiboletus* are characterised by their reticulate stipe, poroid hymenophore, and a tendency to bruise blue when injured. Phylogenetic analyses based on ITS and LSU sequences supported the recognition of *Retiboletus* as a distinct lineage within *Boletaceae* Chevall. (Binder & Bresinsky 2002, Wu et al. 2016c). They are ectomycorrhizal fungi, primarily associated with trees in temperate and tropical forests (Wu et al. 2016c). *Retiboletus* species are mainly distributed across the Northern Hemisphere, including North America, Europe, and East Asia (Binder & Bresinsky 2002). Some taxa have also been reported from Central America and parts of subtropical Asia, though they are less diverse in tropical zones compared to other boletes (Zeng et al. 2016, Liu et al. 2020).

The basidiomata of *Retiboletus* are typically stipitate, with a convex to applanate pileus that is dry and often finely tomentose. The stipe is prominently reticulate near the apex, which serves as a key diagnostic feature. The hymenophore is poroid, with yellow to olive pores that bruise blue when injured (Binder & Bresinsky 2002). Basidiospores are smooth, ellipsoid to subfusoid, and the hyphal system is monomitic. Clamp connections are typically absent (Binder & Bresinsky 2002, Liu et al. 2020). Species of *Retiboletus* form symbiotic ectomycorrhizal relationships with various tree species, aiding in nutrient acquisition and soil stabilisation (Smith & Read 2010). Though not commonly consumed, some species may be edible, albeit less favoured due to their bitter taste or rapid discolouration. Their role in forest health, however, is ecologically significant (Kuo 2017, Mushroom Monday 2024).

Molecular studies have further clarified the taxonomy of *Retiboletus*, with multi-gene phylogenies including ITS, LSU, *tef-1α*, *rpb1*, and *rpb2*, supporting the delineation of species within the genus. Phylogenetic analyses confirm *Retiboletus* as a well-defined clade within *Boletaceae*. However, morphological overlap with *Boletus* and *Aureoboletus* Pouzar, mainly concerning stipe ornamentation and hymenophore features, has led to confusion in field identification (Wu et al. 2016c, Zeng et al. 2016, Liu et al. 2020). Within *Retiboletus*, Hyde et al.

(2024a) recognised only 17 species worldwide. The classification of *Retiboletus* in *Boletaceae, Boletales, Agaricomycetidae, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* is in agreement in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Type species: *Retiboletus ornatipes* (Peck) Manfr. Binder & Bresinsky

Basionym: *Boletus ornatipes* Peck

Other accepted species: (Species Fungorum – search *Retiboletus*)

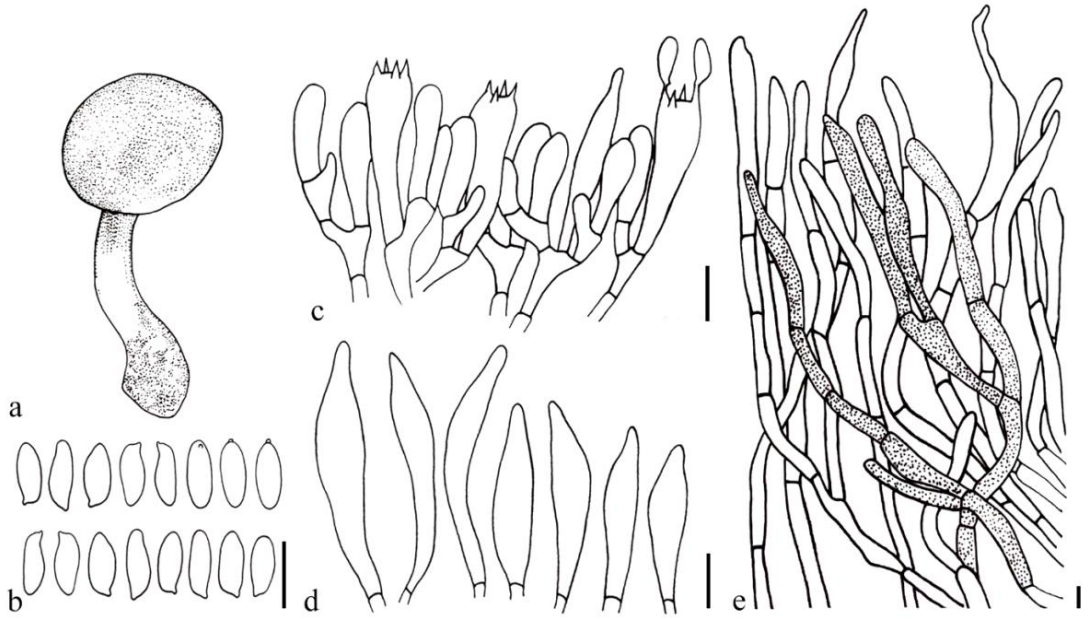


Fig. 109 – ***Retiboletus ater***. a Basidiomata. b Basidiospores. c Basidia and pleurocystidium. d Cheilo- and pleurocystidia. e Pileipellis. Scale bars: b–e = 10 μm. Redrawn from Liu et al. (2020). For original basidiomata, refer to Liu et al. (2020).

Strobilomyces Berk., Hooker's Journal of Botany and Kew Garden Miscellany 3, 78

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 110

Classification: *Boletaceae, Boletales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Strobilomyces was established by Berkeley in 1851 (Akata 2012) and is commonly known as the old man of the woods in Europe. *Strobilomyces* is cosmopolitan in distribution (Sato et al. 2005, Akata 2012), and East Asia is the centre of species diversity for this genus (Han et al. 2018b). Species of *Strobilomyces* form ectomycorrhizal associations with *Casuarinaceae*, *Dipterocarpaceae*, *Fabaceae*, *Fagaceae*, *Myrtaceae*, and *Pinaceae* (Sato et al. 2017, Han et al. 2018b, Han et al. 2020). Morphologically, usually dry pileus, coarsely to scaly, black, blackish-brown, reddish-brown, greyish, or golden yellow cap with partial veils (Arora 1986, Singer 1986, Akata 2012, Han et al. 2018b). Pore surface is white when young and becomes black with maturity (Das et al. 2014). Stipe is dry, woolly to shaggy and partly reticulated or smooth with or without an annulus, mostly concolourous to pileus (Arora 1986, Akata 2012, Das et al. 2014). Upon bruising, the stipe flesh converts from reddish to blackish and blackish brown (Singer 1986, Antonin et al. 2015) with blackish brown to black spores (Das et al. 2014). Basidiospores are globose to broadly ellipsoid with partial to complete reticulate and subcristate to verrucose ornamentation (Singer 1986, Das et al. 2014, Antonin et al. 2015).

Antonin et al. (2015) described a new species, *Strobilomyces pteroreticulosporus*, based on morphological characteristics, ecological data, and molecular analyses (ITS and *rpb1*). In addition, Han et al. (2018b) used four gene markers (*rpb1*, *rpb2*, *tef-1α*, and *cox3*) to support a new taxon, *S. rubrobrunneus*. Based on combined analysis of phylogeny, morphology, host tree associations, and

geographical distribution patterns, the new classification consists of two sections, *Strobilomyces* and *Echinati* (Han et al. 2020). Pegler and Young (1981) erected a new genus, *Afroboletus* Pegler & T.W.K. Young, to include species of *Echinati*. However, phylogenetic analysis reveals that both *Strobilomyces* and *Afroboletus* are monophyletic and form a sister group (Han et al. 2020). Within *Strobilomyces,* Hyde et al. (2024a) recognised only 62 species. The classification of *Strobilomyces* in *Boletaceae, Boletales, Agaricomycetidae, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* is in agreement in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Type species: *Strobilomyces strobilaceus* (Scop.) Berk.

Basionym: *Boletus strobilaceus* Scop.

Other accepted species: (Species Fungorum – search *Strobilomyces*)

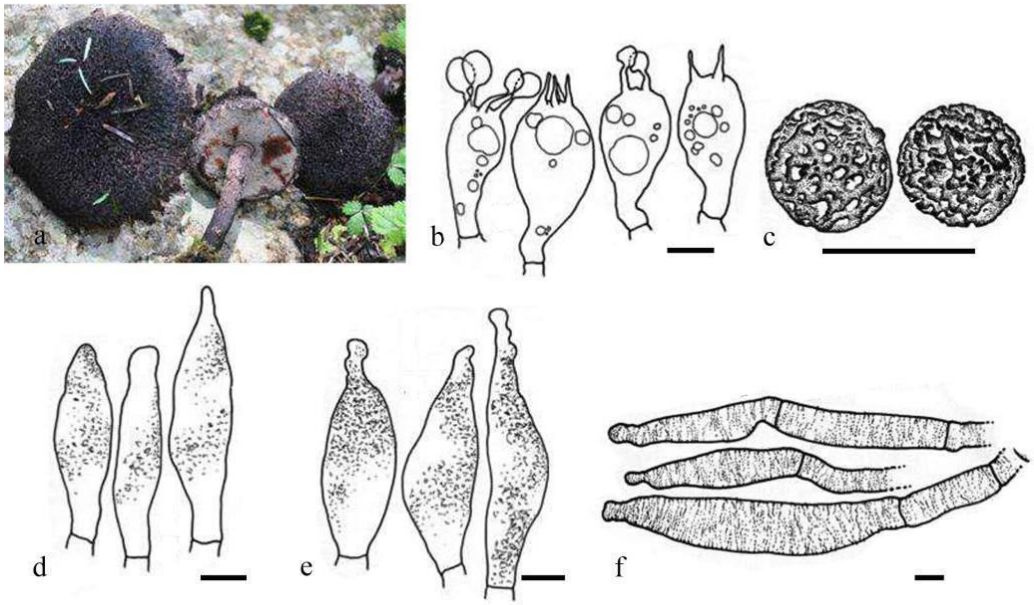


Fig. 110 – ***Strobilomyces***. a Basidiomata of *S. sikkimensis*. b Basidia of *S. polypyramis*. c Basidiospores of *S. polypyramis*. d Cheilocystidia of *S. polypyramis*. e. Pleurocystidia of *S. polypyramis*. f Terminal cells of hyphal elements of *S. polypyramis*. Scale bar: b−f = 10 µm. Photo credit: Das et al. (2014). Redrawn from Das et al. (2014).

Veloporphyrellus L.D. Gómez & Singer, Brenesia 22, 293

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 111

Classification: *Boletaceae, Boletales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Veloporphyrellus was established by L.D. Gómez and R. Singer in 1984, with *V. pantoleucus* (Singer & Gómez 1984) as its type species. The type species was described based on specimens collected from soil in the montane forest of *Quercus* and *Magnolia* in Costa Rica (Singer & Gómez 1984). Members of *Veloporphyrellus* form ectomycorrhizal associations with plants from *Caesalpiniaceae*, *Dipterocaceae*, *Fagaceae*, and *Pinaceae* families (Li et al. 2014). Species of *Veloporphyrellus* are found across North and Central America, southeastern Asia, and Africa (Li et al. 2014).

Veloporphyrellus is characterised by the stipitate-pileate basidiomata, with a distinct membranous veil or an appendiculate pileal margin which often embraces the apex of the stipe. The pileus has a white to pallid context, while the hymenophore ranges from white to pinkish. Basidiospores are smooth, with pinkish to brownish pink in spore print; the pileipellis is trichodermial in structure (Singer & Gómez 1984, Li et al. 2014, Wu et al. 2016b).

Veloporphyrellus was originally considered monophyletic (Li et al. 2014). However, Wu et al. (2016b) found that *Veloporphyrellus* species cluster into two distinct clades. The genus shares

the characteristics of membranous veil remnants on the pileus margin with *Austroboletus* (Corner) Wolfe, *Boletellus* Murrill, *Leccinum* Gray, *Strobilomyces* Berk., and *Suillus* Gray. However, *Veloporphyrellus* differs from *Boletellus*, *Leccinum*, and *Suillus* by having a pale pinkish to light pinkish or greyish pink hymenophore and a pink to ocher-purple spore print. It is distinct from *Austroboletus* and *Strobilomyces* by its smooth basidiospores (Li et al. 2014). Hyde et al. (2024a) have recognised ten species of *Veloporphyrellus* worldwide. The classification of *Veloporphyrellus* in *Boletaceae, Boletales, Agaricomycetidae, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* is in agreement in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

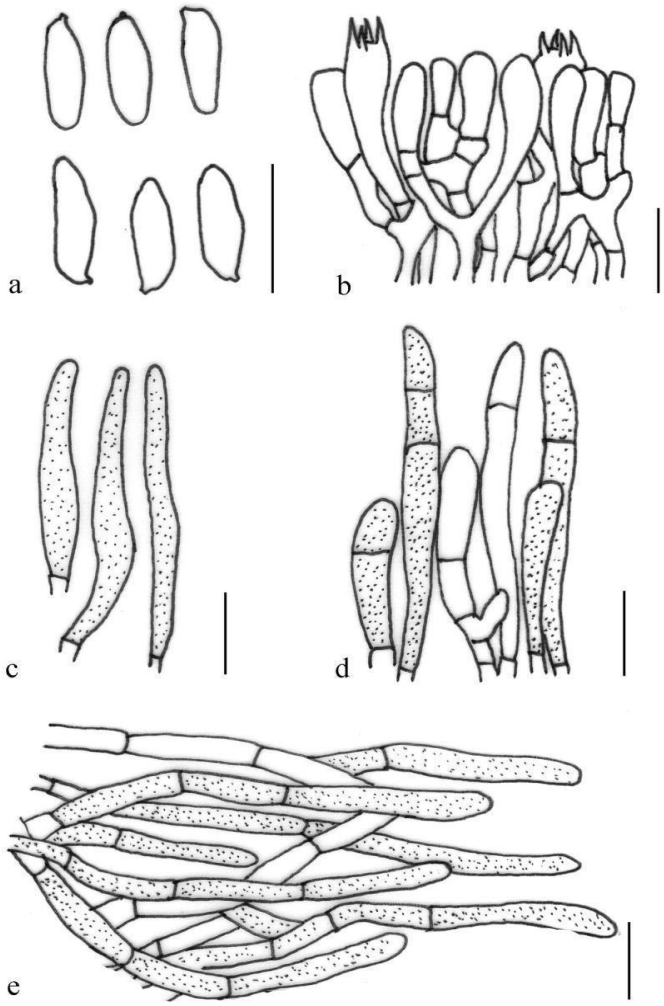


Fig. 111 – ***Veloporphyrellus alpinus***. a Basidiospores. b Basidia and basidioles. c Pleurocystidia. d Cheilocystidia. e Pileipellis. Scale bar: a–e = 20 µm. Redrawn from Li et al. (2014). For original basidiomata, refer to Li et al. (2014).

Type species: *Veloporphyrellus pantoleucus* L.D. Gómez & Singer
Other accepted species:
V. africanus Watling
V. alpinus Yan C. Li & Zhu L. Yang
V. castaneus Yan C. Li & Zhu L. Yang
V. conicus (Ravenel) B. Ortiz, Yan C. Li & Zhu L. Yang
V. gracilioides Yan C. Li & Zhu L. Yang
V. latisporus J. Khan & S. Ullah
V. pseudovelatus Yan C. Li & Zhu L. Yang

V. velatus (Rostr.) Yan C. Li & Zhu L. Yang
V. velpinus T.H.G. Pham, O.V. Morozova, A.V. Alexandrova & E.S. Popov

Coniophoraceae Ulbr., in Lindau, Kryptogamenflora für Anfänger (Berlin), 3(Aufl. 1), 120
Species Fungorum, Facesoffungi, MycoBank, GenBank
Classification: *Boletales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Coniophoraceae was established by G. Lindau (1928) with *Coniophora* DC as its type genus (Lindau 1928). *Coniophoraceae* is characterised by its crust-like basidiomata (He et al. 2024). He et al. (2024) and Hyde et al. (2024a) have recognised six genera in this family: *Chrysoconia* McCabe & G.A. Escobar, *Coniophora*, *Coniophoropsis* Hjortstam & Ryvarden, *Gyrodontium* Pat., *Penttilamyces* Zmitr., Kalinovskaya & Myasnikov, and *Sedecula* Zeller. Members of *Coniophoraceae* are distributed worldwide and are saprophytic, with some species being pathogenic (*Coniophora puteana* (Schumach.) P. Karst.), causing brown rot (Irbe et al. 2011, He et al. 2019).

Chrysoconia McCabe & G.A. Escobar, Mycotaxon 9(1), 240
Species Fungorum, Facesoffungi, MycoBank Fig. 112
Classification: *Coniophoraceae, Boletales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Chrysoconia is a monotypic genus with *C. orthospora* McCabe & G.A. Escobar designated as the type species (McCabe & Escobar 1979, Hyde et al. 2024a). This genus was established by McCabe & Escobar in 1979. Species of *Chrysoconia* are easily distinguished from the other genera of *Coniophoraceae* by their dendritic to hemispherical basidiomata comprising hyaline clamped hyphae and by orthotropically attached basidiospores (McCabe & Escobar 1979, Hyde et al. 2024a). *Chrysoconia orthospora* is characterised by its gasterocarpic, hemispherical to dendroid basidiocarps. The basidia are clavate-shaped, 2-spored, and present across all surfaces of the basidiomata. The basidiospores are smooth-walled, brownish, cyanophilous, and elliptical, with a thin-walled pedicel and an apical germ pore. This species is saprotrophic and was found growing on decaying vegetable matter (McCabe & Escobar 1979, Watling 2008).

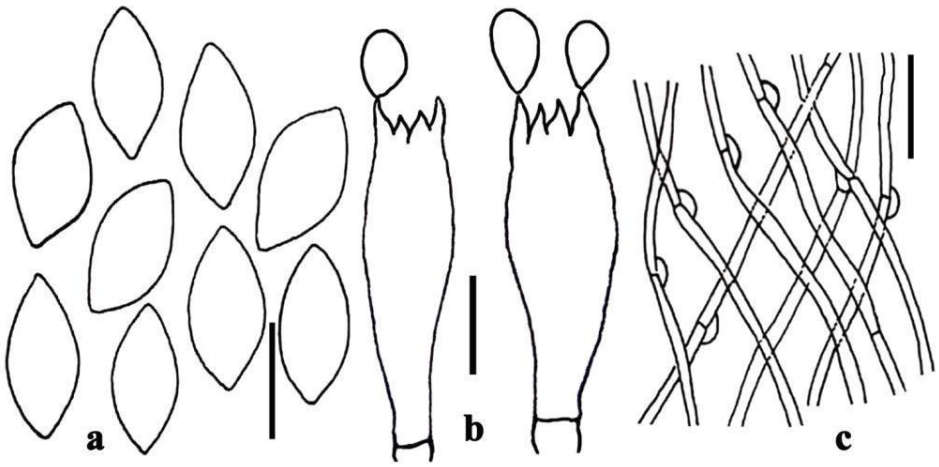


Fig. 112 – ***Chrysoconia orthospora***. a Basidiospores. b Basidia. c Hyphae bearing clamp connections. Scale bars: a–c = 10 μm. Redrawn from McCabe & Escobar (1979).

Watling (2008) redescribed the sole species *Chrysoconia orthospora* from North America based on morphological characters (Washington, USA). The genus is placed in *Coniophoraceae* as a gasteroid member; however, another genus, *Sedecula*, also shows a gasteroid (pulvinate) habit, but the presence of clamp-connected hyphae and orthotropically attached basidiospores distinguishes it from the latter (Valda & Kolařík 2024). Members of this genus lack molecular

sequences, indicating the necessity of further investigation (He et al. 2019). The classification of *Chrysoconia* in *Coniophoraceae, Boletales, Agaricomycetidae, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* is in agreement in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Type species: *Chrysoconia orthospora* McCabe & G.A. Escobar

Coniophora DC., Flore Française, Édition 3, Tome 5/6, 34

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 113

Classification: *Coniophoraceae, Boletales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Coniophora was established by De Candolle in 1815 (Blanco et al. 2009). The genus is a widespread corticioid (patch-forming) fungus in temperate and boreal regions, with the first reported in the Cape Verde Archipelago (Binder & Hibbett 2006, Kauserud et al. 2007, Duenas et al. 2023). *Coniophora arida* and *C. olivacea* were investigated based on morphological and combined molecular analyses of ITS, *tef*-1α, and *tub* genes (Kauserud et al. 2007). However, due to the limited number of macro- and micro-morphological characteristics, distinguishing between species remains difficult (Kauserud et al. 2007). *Coniophora* can be found both domestically and in woodlands, with some bearing parasite behaviour (Schmidt et al. 2002). Most *Coniophora* are brown-rotting fungi in all kinds of wood, causing economic loss in the timber sector, and *C. eremophila* causes progressive dieback of lemon trees (Adaskaveg et al. 2001, Schmidt et al. 2002, Duenas et al. 2023).

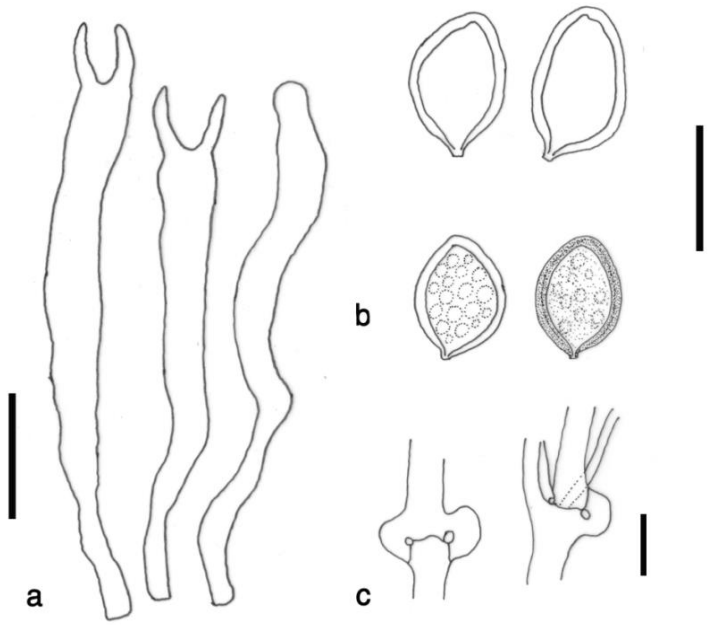


Fig. 113 – ***Coniophora bimacrospora*** (MUCL 45009, holotype). a. Basidia. b. Basidiospores. c. Marginal generative hyphae with multiple clamps. Scale bar: a–b = 20 µm, c =10 µm. Redrawn from Carlier et al. (2004).

Coniophora is distinctive by resupinate, effused, fleshy, adnate, and membranaceous basidiomata; the hymenophore is usually smooth to tuberculate, with the presence of hyphal strands at the margin (Hallenberg 1985, Li & He 2023). This genus exhibits mono-, di-, or trimitic hyphal systems; most generative hyphae are clampless, with scattered double or verticillate clamps in wider marginal generative hyphae, clavate basidia, cylindrical to utriform, with two to four sterigmata but without basal clamps (Ginns 1982, Hallenberg 1985, Adaskaveg et al. 2001, Duenas et al. 2023). The basidiospores are broadly ellipsoid, ellipsoid to ovoid, or subfusiform, and

apiculate, with the presence of an apical germ pore, thick-walled, smooth, yellowish to brownish, and more or less dextrinoid and cyanophilous reactions (Ginns 1982, Hallenberg 1985, Duenas et al. 2023, Li & He 2023). The basidiomata produce xerocomic acid (Schmidt et al. 2002). Within *Coniophora*, Hyde et al. (2024a) have recognised only 50 species worldwide. The classification of *Coniophora* in *Coniophoraceae, Boletales, Agaricomycetidae, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* is in agreement in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Synonymy: *Coniophorella* P. Karst.

Type species: *Coniophora membranacea* DC.

Other accepted species: (Species Fungorum – search *Coniophora*)

Coniophoropsis Hjortstam & Ryvarden, Mycotaxon 25(2), 540

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 114

Classification: *Coniophoraceae, Boletales, Agaricomycetes, Agaricomycotina, Basidiomycota*, *Fungi*

Coniophoropsis was established by Kurt Hjorstam and Leif Ryvarden in 1986, with *C. obscura* as the type species, found in Argentina (Hjortstam & Ryvarden 1986, Kirk et al. 2008). In 2007, Larsson classified *Coniophoropsis* as *incertae sedis* within *Boletales* due to the lack of DNA sequence data for the type species (Zhao et al. 2018). *Coniophoropsis bambusicola* S.H. He & Nakasone is the second species discovered by Zhao and collaborators (2018) from the culm of dead bamboo in southern Vietnam. It was morphologically identified and confirmed through ITS and LSU sequence analysis. Currently, Species Fungorum (2026) lists three species of *Coniophoropsis*.

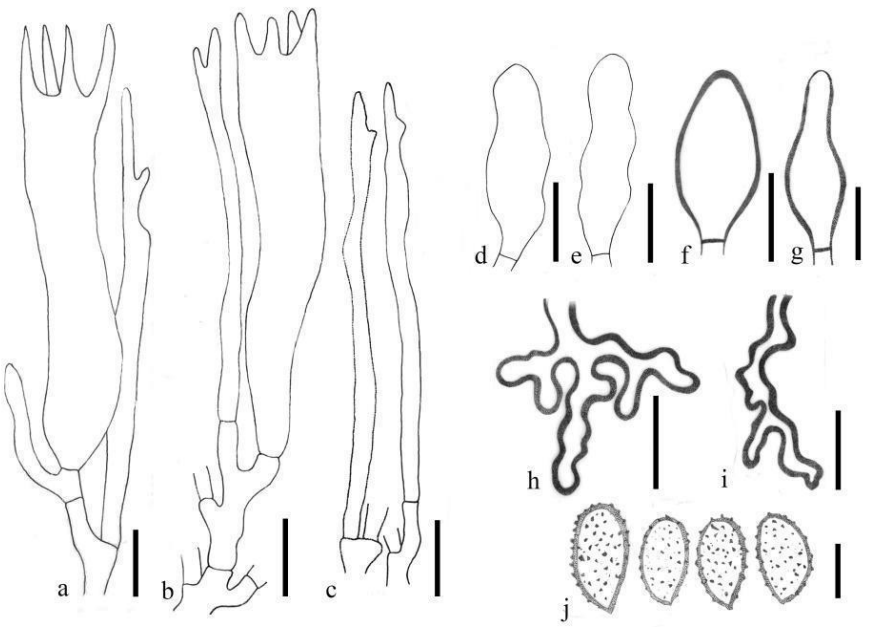


Fig. 114 – ***Coniophoropsis***. a–b Basidia. c Hypoid elements. d–e Basidioles. f–g Gloeocystidia. h–i Dendrohyphidia. j Basidiospores. Scale bars: a–j = 10 μm. Redrawn from Hjortstam & Ryvarden (1986) and Zhao et al. (2018).

Coniophoropsis species feature brown, resupinate basidiomata with a smooth hymenophore, a monomitic hyphal structure, generative hyphae with simple septa, and basidiospores that are verrucose, thick-walled, and cyanophilous (Hjortstam & Ryvarden 1986). *Coniophoropsis* closely resembles *Coniophora* DC., but is distinguished by its ornamented and non-dextrinoid basidiospores and the absence of scattered or verticillate clamps on the basal hyphae (Ginns 1982, Hjortstam & Ryvarden 1986, Zhao et al. 2018). Additionally, the apiculus is smaller, and the germ pore is barely visible, with poorly differentiated dendrohyphidia or hyphal tips extending just above

the basidia (Hjortstam & Ryvarden 1986). The classification of *Coniophoropsis* in *Coniophoraceae, Boletales, Agaricomycetidae, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* is in agreement in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Type species: *Coniophoropsis obscura* Hjortstam & Ryvarden

Other accepted species:

C. bambusicola S.H. He & Nakasone

C. sinensis Yang & C.L. Zhao

Gyrodontium Pat., Essai Taxonomique sur les Hyménomycètes (Lons-le-Saunier), 117

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 115

Classification: *Coniophoraceae, Boletales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Gyrodontium was established by Patouillard in 1900 and is typified by *G. sacchari* (Leonardo-Silva et al. 2023). *Gyrodontium* is cosmopolitan, except in Antarctica, mainly in pantropical regions of the world (Carlier et al. 2004, Robledo et al. 2014, He et al. 2019, Leonardo-Silva et al. 2023). Within *Gyrodontium*, Hyde et al. (2024a) have recognised two species worldwide. Species of *Gyrodontium* cause brown rot and occur primarily on dead wood and in man-made environments such as wooden houses and bridges (Carlier et al. 2004).

Gyrodontium is characterised by resupinate to piliate basidiomata and yellowish olive to olive brown to brown toothed hymenium, which is cylindrical to angular (Carlier et al. 2004). *Gyrodontium* bears a monomitic hyphal system with clampless generative hyphae and ellipsoid, yellowish thick-walled basidiospores (Carlier et al. 2004). Basidiome context bears thick-walled, yellowish chlamydospores (Carlier et al. 2004).

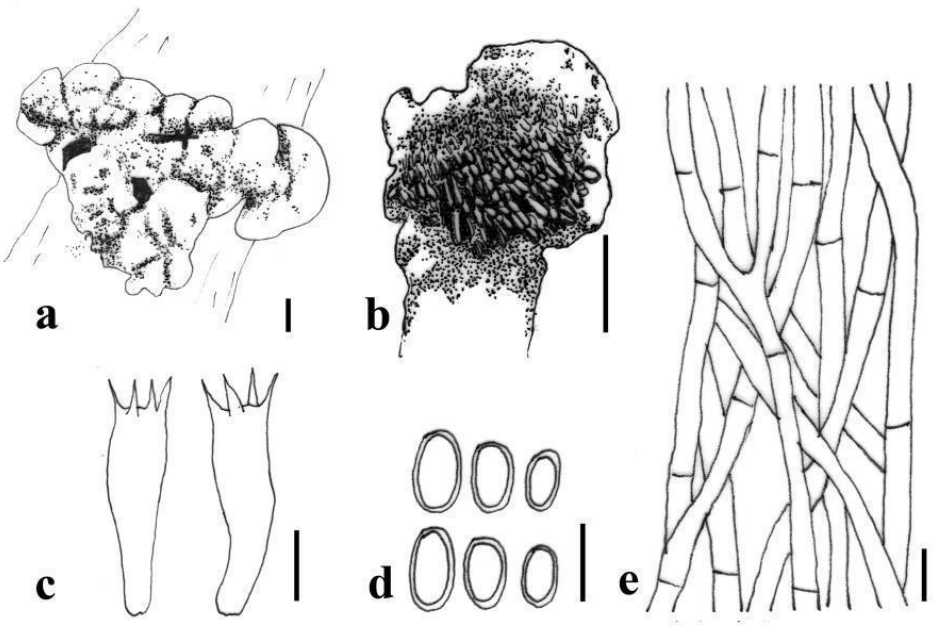


Fig. 115 – ***Gyrodontium sachhari***. a Pilial surface of basidiomata. b Hymenial surface of basidiome. c Basidia. d Basidiospores. e Hypahe of hymenophoral trama. Scale bars: a–b = 1 cm, c−e = 5 µm. Redrawn from: a–b = Leonardo-Silva et al. (2023), c−e = Valenzuela et al. (2012).

Species of *Gyrodontium* were previously named *Hydnum* due to spores produced in a structure resembling tooth-like or spinous hymenophores (Leonardo-Silva et al. 2023). Subsequently, with advancements in molecular phylogenetics, they were transferred to *Gyrodontium* (Leonardo-Silva et al. 2023). Binder et al. (2010) employed six-locus analysis (ITS, LSU, SSU, *rpb1*, *rpb2*, and *tef-1α*) to differentiate strains of *Agaricales*, *Boletales*, and *Atheliales*,

including *Gyrodontium sachhari*. *Gyrodontium* is closely related to *Coniophora* in phylogenetic analyses, and both species bear simple septate generative hyphae; however, *Gyrodontium* has a toothed hymenial surface, whereas *Coniophora* has smooth basidiomata (Carlier et al. 2004, Valenzuela et al. 2012). The classification of *Gyrodontium* in *Coniophoraceae, Boletales, Agaricomycetidae, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* is in agreement in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Synonymy: *Boninohydnum* S. Ito & S. Imai

Type species: *Gyrodontium sachhari* (Spreng.: Fr.) Hjortstam

Basionym: *Hydnum sacchari* Spreng.

Other accepted species: *G arizonicum* (Ginns) Zmitr., Kalinovskaya & Myasnikov

Sedecula Zeller, Mycologia 33(2), 212

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 116

Classification: *Coniophoraceae, Boletales, Agaricomycetes, Agaricomycotina, Basidiomycota*, *Fungi*

Sedecula is a monotypic genus established by Sanford Myron Zeller in 1941, with its type species, *S. pulvinata*, inhabiting dry conifer forests of the western United States (Zeller 1941, Hyde et al. 2024a). Additional occurrences of this genus have been reported from the Czech Republic, Canada, Pakistan, and Central Europe (Valda & Kolarik 2024). *Sedecula* associates with various conifers, including *Abies concolor*, *A. lasiocarpa*, *A. magnifica*, *Picea engelmannii*, and *Pinus contorta*, as well as deciduous forests dominated by *Populus angustifolia* (Castellano et al. 1999, Valda & Kolarik 2024, Van Nuland et al. 2021). The genus is considered rare and is listed by the Interagency Special Status/Sensitive Species Program (ISSSSP) for the protection of known habitats (Castellano et al. 1999). However, new geographical evidence from Valda and Kolarik (2024) suggests it may have a broader ecological range than previously thought.

Sedecula species are characterised by underground or semi-subterranean basidiomata (Zeller 1941, 1948, 1949). They feature hypogeous, pulvinate, leathery basidiomata and lack a sterile base or radicle (Zeller 1948). The peridium is thick and leathery on top but almost absent below, dehiscing from the underside (Trappe et al. 2015, Valda & Kolarik 2024). The gleba is black, with broad whitish veins extending inward from the peridium, becoming powdery (Trappe et al. 2015). *Sedecula* develops centripetally, with a complete reduction of the stipe and sterile base, leaving little to no sterile tissue on the lower surface of the fructification, where the gleba is nearly exposed (Zeller 1948). The continuity of the centripetal tramal plates with the centre-base of the basidiome suggests that this genus is neotenic. The basidiospores are brown, ellipsoid to irregular, and smooth (Zeller 1941).

Initially, Zeller (1941) classified *Sedecula* within *Sclerodermataceae* Corda due to its heavy, leathery peridium and glebal characteristics (Trappe et al. 2015). However, in 1948, it was reclassified within *Sedeculaceae* Zeller based on distinct features such as basidiospore morphology and the centripetal development of the gleba (Zeller 1948, 1949, Guzman 1971). This reclassification was supported by Smith (1951) and Guzman (1971). Later, Thiers (1984) speculated that *Sedecula* might be related to *Agaricus* L. due to the morphological similarity of their large, smooth basidiospores. Subsequent evidence from hyphal morphology (Agerer 1999) and molecular phylogenetic data (Binder & Bresinsky 2002, Binder & Hibbett 2006) showed that *Sclerodermataceae* is nested within *Boletales* E.J. Gilbert. Based on isotopic and molecular phylogenetic analyses of several genetic loci: ITS, LSU, and *tef-1α*. Trappe et al. (2015) concluded that *S. pulvinata* is more closely related to *Coniophora* DC., within *Coniophoraceae* Ulbr., representing a unique morphological transition between resupinate basidiomata (seen in *Coniophora* and relatives) and hypogeous, sequestrate basidiomata. The classification of *Sedecula* in Species Fungorum, UNITE, and Hyde et al. (2024a) is under *Coniophoraceae*, whereas GenBank lists it under *incertae sedis* and may need updating.

Sedecula pulvinata was reported as an ectomycorrhizal fungus found after passage through the digestive tract of a mycophagous tassel-eared squirrel (*Sciurus aberti*) (Colgan & Claridge 2002). However, stable isotope analysis of nitrogen and carbon ratios in the fruit bodies indicates that *Sedecula* is saprotrophic, obtaining nutrients similar to the related *Coniophora* (Trappe et al. 2015, Valda & Kolarik 2024). Furthermore, the unique phylogenetic position among saprotrophs that form brown rot confirms the saprobic mode of *Sedecula* (Valda & Kolarik 2024).

Type species: *Sedecula pulvinata* Zeller

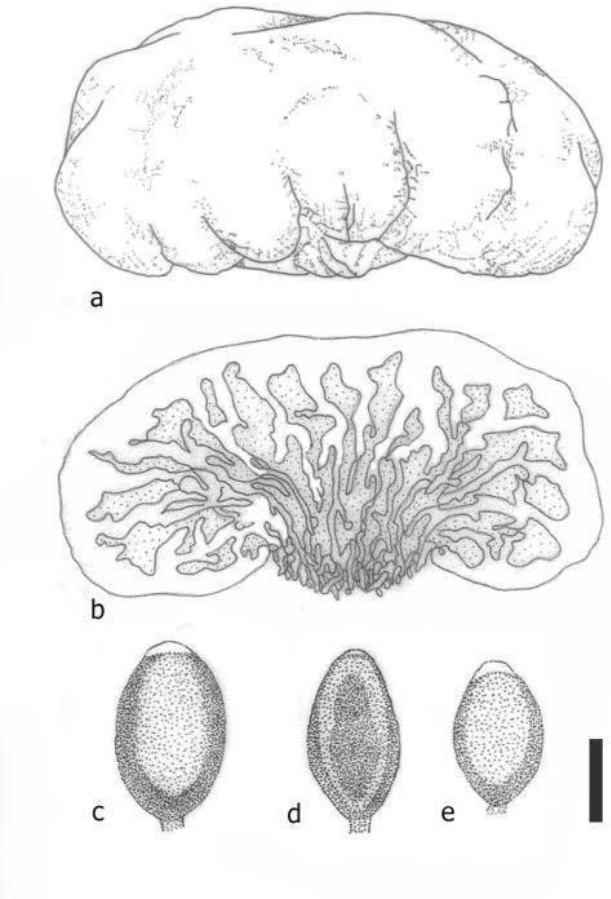


Fig. 116 – ***Sedecula pulvinata***. a Basidiomata. b Vertical median section. c Basidiospores. Scale bars: c–e = 20 µm. Redrawn from Zeller (1941).

Gomphidiaceae Maire ex Jülich, Bibliotheca Mycologica 85, 369

Species Fungorum, Facesoffungi, MycoBank, GenBank

Classification: *Boletales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Gomphidiaceae is a small family established by W. Jülich (1982) with *Gomphidius* Fr. as the type genus (Jülich 1982). *Gomphidiaceae* is characterised by lamellate basidiomata and comprises four genera: *Chroogomphus* (Singer) O.K. Mill., *Cystogomphus* Singer, *Gomphidius*, and *Gomphogaster* O.K. Mill. (He et al. 2024, Hyde et al. 2024a). Species of *Gomphidiaceae* are distributed worldwide and form ectomycorrhizal associations with tree roots of *Pinaceae*, *Piceoideae*, *Lariceideae*, and *Abietoideae* (Miller Jr 2003, He et al. 2019). Some species of this family are popular for edible purposes (*Gomphidius glutinosus* (Schaeff.) Fr.), and some species are used for medicinal purposes (*Chroogomphus rutilus* (Schaeff.) O.K. Mill., *G. rutilus* (Schaeff.) S. Lundell) (Dai & Yang 2008, Gao et al. 2013).

Chroogomphus (Singer) O.K. Mill., Mycologia 56(4), 529

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 117

Classification: *Gomphidiaceae, Boletales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Initially, *Chroogomphus* was described as a subgenus under *Gomphidius* Fr. in *Gomphidiaceae* Maire ex Jülich (Miller Jr 1964). Later, it was raised to a generic level, typified by *Chroogomphus rutilus* (Schaeff.) O.K. Mill., due to certain distinguishing characteristics from other discussed subgenera of *Gomphidius*, including pink ochraceous gills in young caps, a moist to viscid, and non-glutinous pileus, presence of ochraceous flesh in the pileus trama, positive Feulgen reaction in stained chromatic material, and amyloid tramal hyphae (Miller Jr 1964). The members grow solitary to scattered in strands of mixed forest of *Larix*, *Pinus*, *Picea*, *Pseudotsuga*, and *Tsuga* (Miller Jr 1964, Scambler et al. 2018). The members of the genus have been observed across North and South America, Europe, China, Japan, and Russia (Miller Jr 1964, Li et al. 2009).

Morphologically, species belonging to *Chroogomphus* are characterised by small to large, expanded (sectioid in one species, *C. albipes* (Zeller) Yan C. Li & Zhu L. Yang) basidiomata (Scambler et al. 2018). Pileus surface is smooth or coarsely fibrillose, viscid to dry, and bright orange to dark reddish brown to purple or leaden-grey (Miller Jr 1964, Scambler et al. 2018). Lamellae are decurrent, ochraceous to pale salmon lamellae turning smoky brown by black spores, exceptionally in *C. mediterraneus,* rarely purple, turning greyish orange to brown with maturity (Miller Jr 1964, Scambler et al. 2018). Pileus and stipe context are concolourous, pale orange to orange-yellow (Scambler et al. 2018). Stipe surface is sparsely fibrillose, white to grey, or pinkish salmon, and occasionally yellow at the base, remnant of the veil in the form of a ring present on the upper part (Miller Jr 1964, Scambler et al. 2018). Basidiospores are boletoid, subfusiform to elliptical, smooth, greyish-brown in KOH, weak to strongly dextrinoid (Miller Jr 1964, Scambler et al. 2018). Hymenium cystidia are cylindrical to clavate, or fusiform, thin- to slightly thick-walled, yellow-brown to vinaceous in KOH, hyaline to yellowish or blue in Melzer's solution (Miller Jr 1964).

Species delineation in the genus depends on the size of the basidiospore, cystidial wall thickness, width, and degree of gelatinisation of hyphae in the pileipellis, and colour of the mycelium at the base of the stipe (Scambler et al. 2018). Recently, three subgenera — *Chroogomphus, Floccigomphus,* and *Siccigomphus* — and five sections — *Chroogomphus, Confusi, Filiformes, Fulminei*, and *Vinicolores* — have been recognised within the genus (Scambler et al. 2018). Within *Chroogomphus,* Hyde et al. (2024a) have recognised 28 species worldwide.

The sister genus, *Gomphidius* Fr., shares similarities with *Chroogomphus* in having decurrent lamellae and greyish to black basidiospore deposits. However, the former is differentiated by its pallid to white lamellae when young, white pileus context, gelatinised pileipellis and veil, and presence of inamyloid to dextrinoid hyphae at the base of the stipe (Scambler et al. 2018).

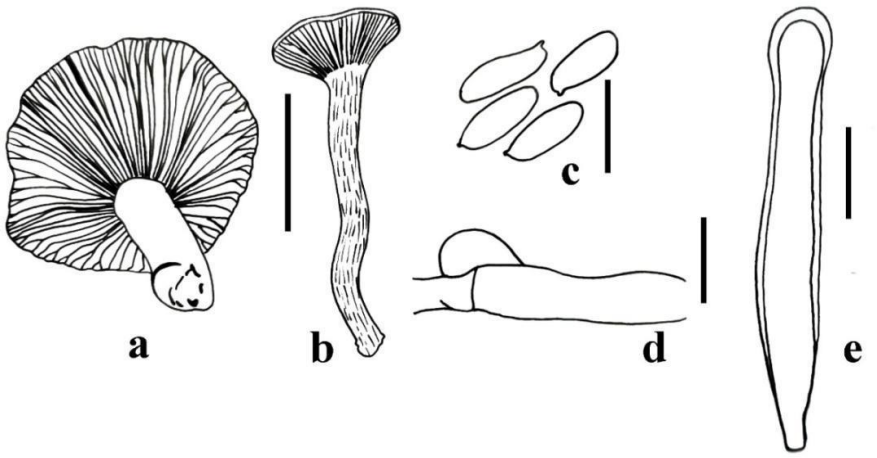


Fig. 117 – ***Chroogomphus rutilus***. a, b Basidiomata. c Basidiospores. d Hyphae with clamp connection. c Thick-walled cystidia in hymenium. Scale bars: a–e = 10 μm. Redrawn Fig. a, d from

Miller Jr (1964), and Fig. b, c, e from Scambler et al. (2018). For original basidiomata, refer to Scambler et al. (2018) and GBIF (2024).

Chroogomphus is known for different phytochemical constituents, including polysaccharides, fatty acids, proteoglycans, sterols, nucleosides, polysaccharide conjugates, and a few nucleosides (Luo et al. 2015). About 29 secondary metabolites have been elucidated from *C. rutilus*. Basidiomata are collected for food or herbal medicine (Li et al. 2009). Molecular studies based on ITS have suggested that *Chroogomphus* forms a monophyletic clade (Li et al. 2009, Scambler et al. 2018). The classification of *Chroogomphus* in *Gomphidiaceae, Boletales, Agaricomycetidae, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* is in agreement in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Synonyms: *Gomphidius* subgen. *Chroogomphus* Singer

Type species: *Chroogomphus rutilus* (Schaeff.) O.K. Mill.

Other accepted species: (Species Fungorum – search *Chroogomphus*)

Cystogomphus Singer, Annales Mycologici 40(1/2), 51

Species Fungorum, Facesoffungi, MycoBank Fig. 118

Classification: *Gomphidiaceae*, *Boletales*, *Agaricomycetes*, *Agaricomycotina*, *Basidiomycota*, *Fungi*

Cystogomphus is a monotypic genus established by Singer in 1942 (He et al. 2019, Hyde et al. 2024a). *Cystogomphus humblotii* was designated as the type species and was originally found in France (He et al. 2019). Initially, this genus was based on *Gomphidius tomentosus* as described by Humblot in 1926. However, it has not been re-found (Watling 2008). *Gomphidius tomentosus*, known as *Chroogomphus* (Singer) Mill. in Northwestern America, significantly differs from Humblot's interpretation, prompting the establishment of a new species and genus based on its unique morphological characteristics (Miller Jr 1971).

Cystogomphus is characterised by a fugacious veil consisting of sphaerocysts, which is putrescent and velangiocarpic, leaving scaly remnants on the cap surface and a ring on the stipe (Singer 1942c, Watling 2008). Basidiomata are epigeal, pileate, and have a lamellate hymenophore, with a centrally positioned stipe. The spore print is blackish. The pileus is almost globose with an incurved margin that becomes convex and slightly flattened, cream-orange in colour, and covered with a cinnabar-red, granular veil that forms small scales, especially at the centre. The margin is appendiculate. The stipe tapers downward, matches the pileus in colour, and has a distinct annulus. It is ornamented below with small scales like those on the pileus, smooth above, and turns cinnabar-red, mottled with black from spores. The gills are decurrent, purple then blackish with white margins, and broadly spaced. The context is white in the pileus and blackens in the stipe. The odour is slightly of anise, and the taste is mild. The basidia are clavate and 4-spored. Basidiospores are ellipsoid-fusiform with a hilar depression, apiculate but without a pore, thick-walled, and black. Cheilocystidia are in clusters at the margin, hyaline, non-encrusted, and pyriform, while pleurocystidia are enormous, cylindric-stipitate, and slightly encrusted towards the apex. The pileipellis consists of rounded cells with a rosaceous membrane. The hymenophoral trama is divergent with broad hyphae that are initially compacted and later become floccose (Singer 1942c, Watling 2008).

Cystogomphus was found in plantations of exotic conifers and is considered potentially ectomycorrhizal with *Picea* (Singer 1942c). However, its mycorrhizal associations are still unknown. The type and only known specimen for this genus may have been lost, and sequence data are also unavailable (He et al. 2019). The classification of *Cystogomphus* in *Gomphidiaceae, Boletales, Agaricomycetidae, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* is in agreement in Species Fungorum, MycoBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Type species: *Cystogomphus humblotii* Singer

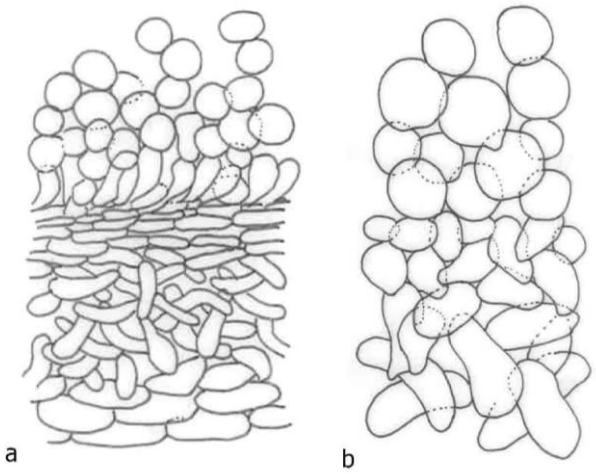


Fig. 118 – ***Cystogomphus humblotii***. a Stipe structures. b Pileus surface. Redrawn from Humblot (1926).

Gomphogaster O.K. Mill., Mycologia 65(1), 227

Species Fungorum, Facesoffungi, MycoBank Fig. 119

Classification: *Gomphidiaceae, Boletales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Gomphogaster is a monotypic genus established in 1973 by Miller Jr to accommodate its type species, *G. leucosarx* (Miller Jr 1973, Hyde et al. 2024a). *Brauniellula leucosarx* was transferred from *Brauniellula* A.H. Sm. & Singer to *Gomphogaster,* due to some contrasting characters from the former genus, including the presence of a white peridium context, non-amyloid hyphae in the context, and a yellow base of the stipe-columella (Miller Jr 1973). The transfer of *Gomphogaster leucosarx* to *Gomphidius leucosarx* was proposed, but without molecular data, it was not supported (Miller Jr 2003).*Gomphogaster* is reported from the USA only (He et al. 2019). In the IUCN Red List, *Gomphogaster leucosarx* is listed as "Data Deficient" (Cunha & Gonçalves 2025).

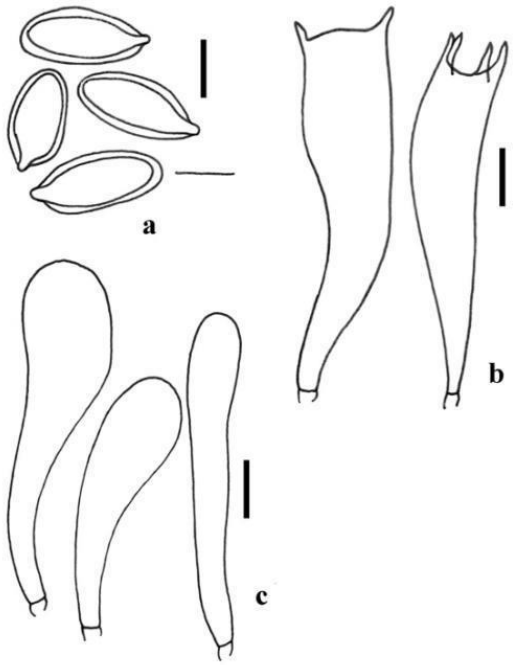


Fig. 119 – ***Gomphogaster leucosara***. a Basidiospores. b Basidia. c Cystidia. Scale bar: a = 10 μm. Redrawn from Miller Jr (1973).

Gomphogaster is characterised as gasteroid basidiomata, convex-depressed to irregularly shaped and pale vinaceous in colour (Miller Jr 1973). Peridium is solid, initially white, and later turns to tinted vinaceous buff with maturity. The gleba comprises small chambers, with few lamellate-like structures, free from columella except at the apex near the peridium, and is light-brown in colour. The stipe-columella is solid, percurrent, white within, dull white, and ending with a yellow base. Basidiospores are ellipsoidal, smooth-walled, thick-walled, and brown. Basidia are clavate and 2- or 4-spored. Cystidia are clavate to fusoid-ventricose shaped, slightly thick-walled. Peridium trama comprises thin-walled, non-amyloid hyphae lacking clamp connections (Miller Jr 1973). No molecular data is available for this genus (Miller Jr 2003, He et al. 2019). The classification of *Gomphogaster* in *Gomphidiaceae, Boletales, Agaricomycetidae, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* is in agreement in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Type species: *Gomphogaster leucosarx* (A.H. Sm. & Singer) O.K. Mill.

Basionym: *Brauniellula leucosarx* A.H. Sm. & Singer

Paxillaceae Lotsy, Vorträge über botanische Stammesgeschichte 1, 706

Species Fungorum, Facesoffungi, MycoBank, GenBank

Classification: *Boletales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Paxillaceae was established by J.P. Lotsy (1907) with *Paxillus* Fr. as the type genus (Lotsy 1907). *Paxillaceae* accommodates lamellate, truffle-like, and boletoid mushrooms and is characterised by the presence of clamp connections and brown staining due to the presence of involutin (Singer 1986, He et al. 2024). Members of *Paxillaceae* are distributed worldwide and form ectomycorrhizal associations with tree roots (He et al. 2019). He et al. (2024) and Hyde et al. (2024a) reported 11 genera in this family: *Alpova* C.W. Dodge, *Austrogaster* Singer, *Gyrodon* Opat., *Hoehnelogaster* Lohwag, *Hydnomerulius* Jarosch & Besl, *Meiorganum* R. Heim, *Melanogaster* Corda, *Neoalpova* Vizzini, *Paragyrodon* (Singer) Singer, *Paralpova* Cabero & P. Alvarado, and *Paxillus*. Some species of this family are edible (*Paxillus involutus* (Batsch) Fr.) (He et al. 2019).

Gyrodon Opat., Archiv für Naturgeschichte 2(1), 5

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 120

Classification: *Paxillaceae, Boletales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Gyrodon was established by Opatowski to accommodate a single species, *G. sistotremoides* (Fr.) Opat. (synonym: *G. lividus* (Bull.) Sacc. (Snell 1941). *Gyrodon*, an ectomycorrhizal fungal genus, has been reported from temperate and tropical regions (Saccardo 1888, Pegler & Young 1981, Singer 1989, Kumla et al. 2017). The asexual morph of the genus is unknown (He et al. 2019). *Gyrodon lividus* is reported to be ectomycorrhizal only with *Alnus* (Karadelev et al. 2007).

Morpho-taxonomic studies were performed to differentiate at the species level, along with multi-locus genes (ITS and LSU) for *G. suthepensis* (Kumla et al. 2017). Species Fungorum (2025) lists 58 records of *Gyrodon,* but some species have been transferred to *Tylopilus*, *Suillus*, *Bothia*, *Boletinellus*, *Boletellus*, *Buchwaldoboletus*, *Phylloporus*, *Paragyrodon*, *Xerocomus*, and *Gyrodontium*. Species Fungorum (2026) have recognised only 17 species of *Gyrodon*. The classification of *Gyrodon* in Species Fungorum, MycoBank, UNITE and Hyde et al. (2024a) is under *Paxillaceae*, whereas GenBank lists it under *Gyrodontaceae* and may need updating. Some edible ectomycorrhizal species, such as *G. lividus* and *G. suthepensis*, possess antioxidant properties (Celal 2018, Wanwaen & Youpensuk 2019). Production trials of edible *Gyrodon* species have been done (Wanwaen & Youpensuk 2019).

Synonymy: *Anastomaria* Raf., *Campbellia* Cooke & Massee, *Gilbertina* R. Heim, *Pseudogyrodon* Heinem. & Rammeloo, *Rodwaya* Syd. & P. Syd., *Uloporus* Quél.

Type species: *Gyrodon lividus* (Bull.) Sacc.

Basionym: *Boletus lividus* Bull

Other accepted species: (Species Fungorum – search *Gyrodon*)

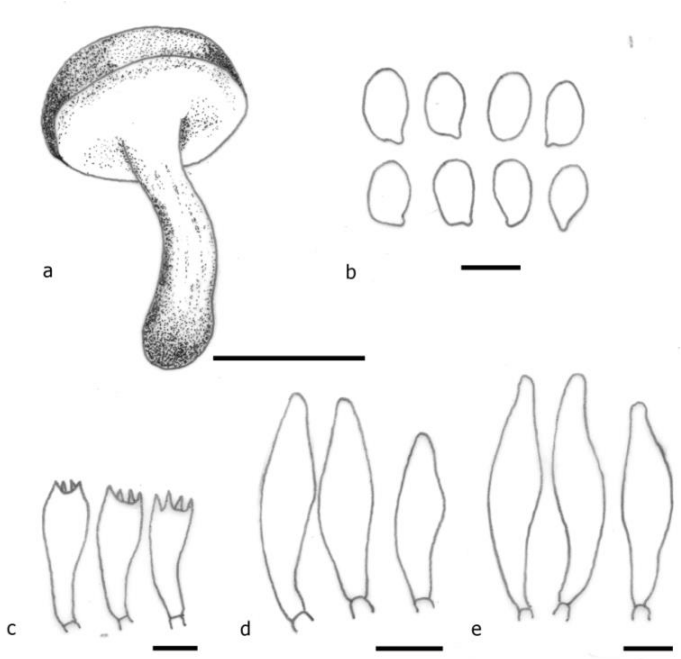


Fig. 120 – ***Gyrodon suthepensis***. a Basidiomata. b Basidiospores. c Basidia. d Pleurocystidia. e Cheilocystidia. Scale bar: a = 5 cm, b = 5 µm, c–e = 10 µm. Redrawn from Kumla et al. (2017).

Meiorganum R. Heim, Comptes rendus hebdomadaires des Séances de l'Académie des Sciences, Paris 261, 1720

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 121

Classification: *Paxillaceae, Boletales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Meiorganum was described by R. Heim in 1965 and typified by *M. neocaledonicum*. Its species are characterised by basidiomata that are effused-reflexed to pileate, yellow to orange-yellow. The hymenophore is distinctive, composed of radially arranged, often anastomosing and highly corrugated folds that resemble lamellae. The context is soft and can emit a strong, cinnamon-like or pungent spicy odour, especially upon drying. It features a monomitic hyphal system with clamped, thick-walled generative hyphae, and ellipsoid to subcylindrical, smooth, inamyloid basidiospores (Singer et al. 1990, López et al. 2015).

Meiorganum curtisii is the most commonly cited species. Molecular phylogenetic analyses based on ITS sequences have been instrumental in clarifying its taxonomy. It is now widely treated as *Pseudomerulius curtisii* (Berk.) Redhead & Ginns, within family *Tapinellaceae* (*Boletales*) (Binder & Hibbett 2006, Baldoni et al. 2012). Phylogenies show *P. curtisii* forms a distinct clade, sister to *P. aureus*, and separate from genera such as *Serpula* and *Tapinella*. Brazilian collections showed a close yet distinct relationship with an Australian specimen, suggesting potential intraspecific variation or a cryptic species (Baldoni et al. 2012). The classification of *Meiorganum* in *Paxillaceae, Boletales, Agaricomycetidae, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* is in agreement in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a). Currently, Species Fungorum (2026) lists four species of *Meiorganum*.

Pseudomerulius curtisii is a brown-rot fungus, primarily found on decayed coniferous wood (e.g., *Pinus* spp.) in temperate and boreal regions. It has a wide distribution across North America, Central America, East Asia, and Oceania, with its first reported South American record from Brazil (Baldoni et al. 2012). The species is considered rare and holds significant biotechnological potential

for the biosynthesis of antioxidant p-terphenyl compounds (Lee et al. 2003, Zhou & Liu 2010, Baldoni et al. 2012).

Type species: *Meiorganum neocaledonicum* R. Heim

Other accepted species:

M. agathidis (Corner) Singer, J. García & L.D. Gómez

M. macrosporum G. Wu & Zhu L. Yang

M. olivaceoflavidum (Cooke & Massee) T.H. Li & Watling

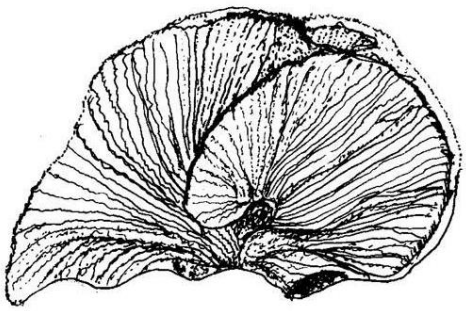


Fig. 121 – ***Meiorganum curtisii***. Redrawn from López et al. (2015). For original basidiomata, refer to López et al. (2015).

Melanogaster Corda, Sturm, Deutschlands Flora, 3. Abtheilung (Die Pilze Deutschlands), Heft 11, 1

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 122

Classification: *Paxillaceae, Boletales, Agaricomycetes, Agaricomycotina, Basidiomycota*, *Fungi*

Melanogaster was established in the early nineteenth century (Corda 1831), and *M. tuberiformis* is the type species of this genus. The characters of this genus are gasteroid hypogeous to semi-hypogeous basidiomata, mycelial strands at the base or surface (sometimes), prosenchymatic peridium, gleba with gelatinous small chambers separated by sterile veins scattered throughout when mature, yellow to dark brown, globose, ellipsoid, pyriform, or fusiform basidiospores (Pegler et al. 1993, Trappe et al. 2009, Moreau et al. 2011,Alvarado et al. 2021, de la Fuente et al. 2021, Xu et al. 2022). This genus was placed in the *Melanogastraceae* and *Hymenogastrales* (Zeller 1949). Then, moved to the family *Paxillaceae* and order *Boletales* of *Basidiomycota* based on molecular data (Binder & Hibbett 2006, Lacheva 2015, Xu et al. 2022). Molecular identification using ITS has been reported (de la Fuente et al. 2021, Xu et al. 2022). They are distributed in the Northern Hemisphere (Europe, North America, and Asia) and the Southern Hemisphere, due to the introduction of oak trees (*Quercus* L.) (Trappe et al. 2009, de la Fuente et al. 2021).

This genus is considered ectomycorrhizal and reported to form mycorrhizal status in broad-leaved and conifer trees (Wang et al. 2005, Rinaldi et al. 2008, Trappe et al. 2009, Tedersoo et al. 2010, Moreau et al. 2011, Türkoğlu & Castellano 2013). According to He et al. (2019), there are 26 species worldwide. Notably, 19 out of 26 species were reported from the north temperate forests (Trappe et al. 2009). However, only a few reports are based on comprehensive taxonomic treatments, Zeller and Dodge (1936) for North American species and Wang et al. (2005) for Asia. The classification of *Melanogaster* in Species Fungorum, MycoBank, UNITE, and Hyde et al. (2024a) is under *Paxillaceae*, whereas GenBank lists it under *Melanogastraceae* and may need updating. Currently, Species Fungorum (2026) lists 33 species of *Melanogaster*.

Synonymy: *Argylium* Wallr., *Bulliardia* Jungh., *Hyperrhiza* Bosc ex Spreng., *Uperhiza* Bosc

Type species: *Melanogaster tuberiformis*

Other accepted species: (Species Fungorum – search *Melanogaster*)

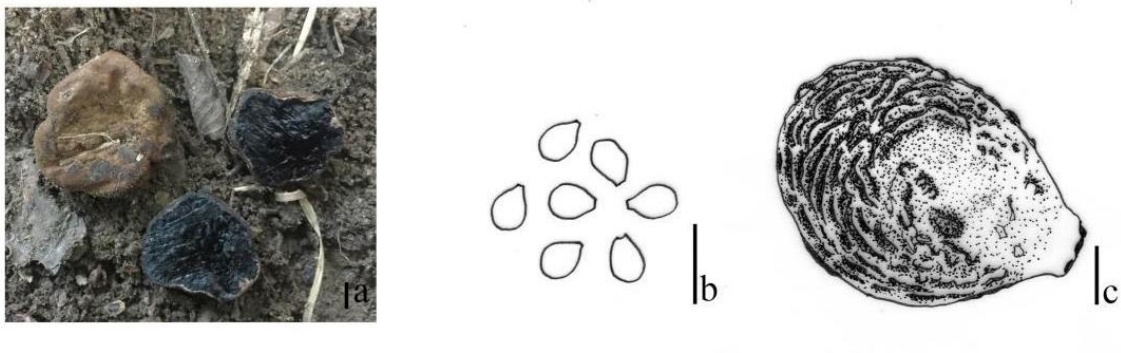


Fig. 122 – ***Melanogaster spinisporus*** (BJTC FAN941-A, epitype). a Basidiomata. b Basidiospores. c SEM of a basidiospore. Scale bar: a = 1 cm, b = 20 µm, c = 2 µm. Redrawn from Xu et al. (2022). The photo has been used under the CC BY 4.0 International non-commercial license.

Paxillus Fr., Flora Scanica, 339

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 123

Classification: *Paxillaceae, Boletales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Paxillus was established by Fries in 1821 (Jargeat et al. 2016). *Paxillus* species form ectomycorrhizal relationships with a range of host plants and are widely distributed in the northern hemisphere (Vellinga et al. 2012). Hyde et al. (2024a) recognised approximately 70 species worldwide. Vellinga et al. (2012) reported two main species clusters: *Paxillus rubicundulus* P.D. Orton, related species associated with *Alnus* hosts and *P. involutus* complexes with a range of host trees. The type species, *P. involutus*, is poisonous due to immune haemolysis (Winkelmann et al. 1986, Jarosch & Bresinsky 1999, Anthowiak et al. 2003).

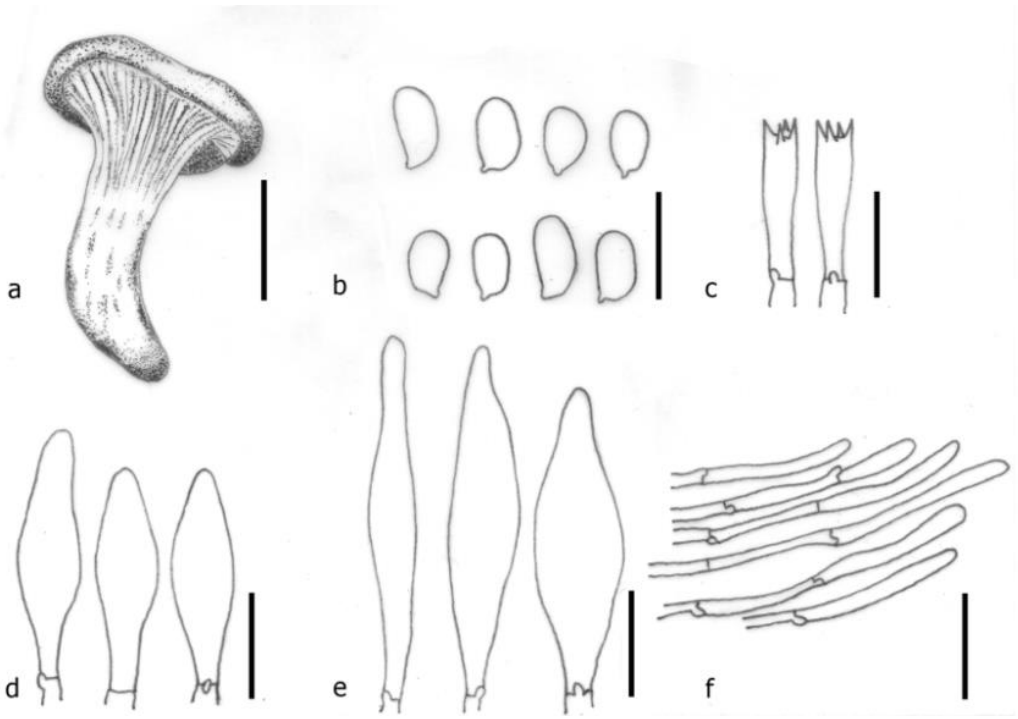


Fig. 123 – ***Paxillus orientalis***. a Basidiomata. b Basidiospores. c Basidia. d Cheilocystidia. e Pleurocystidia. f Pileipellis. Scale bar: a = 2.5 cm, b = 10 µm, c–e = 20 µm, f = 40 µm. Redrawn from Gelardi et al. (2014).

Paxillus fruiting bodies are fleshy, range from medium to large, and exhibit ochraceous-yellow to chestnut-brown or dark-brown colours. Pileus is funnel-shaped, with an involute margin in young sporophores. Lamellae are deeply decurrent, interveined towards the stipe, easily detachable, and reddening or browning tissues on bruising (Gelardi et al. 2014). The trichodermal pileipellis consists of filamentous hyphae, bi-lateral divergent hymenophoral trama, and an absent lateral stipe stratum. Basidiospores are broadly ellipsoid, smooth, and cyanophilic. The spore print is rusty brown to reddish brown. Clamp connections are present (Šutara 1992, Watling 2008, Gelardi et al. 2014).

Paxillus involutus was the only species within *Paxillus* for several decades, serving as the type species (Jargeat et al. 2016). Based on species of the Northern Hemisphere, *Paxillus* has been verified as monophyletic (Watling 2008, Vellinga et al. 2012, Gelardi et al. 2014). Bresinsky et al. (1999) reported that taxa from the Southern Hemisphere form a separate lineage. The challenge of identifying species, given the polymorphic basidiome, is resolved by using the ITS gene as a genetic marker (Hahn & Agerer 1999a, Gelardi et al. 2014). The classification of *Paxillus* in *Paxillaceae, Boletales, Agaricomycetidae, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* is in agreement in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Synonymy: *Parapaxillus* Singer; *Paxillopsis* E.-J. Gilbert; *Rhymovis* Pers. ex Rabenh.; *Ruthea* Opat.

Type species: *Paxillus involutus* (Batsch) Fr.

Basionym: *Agaricus involutus* Batsch

Other accepted species: (Species Fungorum – search *Paxillus*)

Sclerodermataceae Corda, Icones Fungorum Hucusque Cognitorum (Prague) 5, 23

Species Fungorum, Facesoffungi, MycoBank, GenBank

Classification: *Boletales, Agaricomycetes, Agaricomycotina, Basidiomycota*, *Fungi*

Sclerodermataceae is a small family established by A.C.H. Corda (1842) with *Scleroderma* Pers. as the type genus (Corda 1842). Guzmán (1971) emended the family, and characterised it by sequestrate basidiomata with knots of basidia rather than a hymenium, echinulate basidiospores, and the absence of capillitium. The family consists of five genera: *Chlorogaster* Læssøe & Jalink, *Favillea* Fr., *Horakiella* Castellano & Trappe, and *Pisolithus* Alb. & Schwein., and *Scleroderma* (He et al. 2024, Hyde et al. 2024a). Members of this family are distributed worldwide and form ectomycorrhizal associations with the roots of trees (He et al. 2019). Some species of *Sclerodermataceae* are considered edible and medicinal, including *Pisolithus arhizus* (Scop.) Rauschert and *Scleroderma areolatum* Ehrenb. (Dai & Yang 2008, He et al. 2019).

Chlorogaster Læssøe & Jalink, Persoonia 18(3), 421

Species Fungorum, Facesoffungi, MycoBank Fig. 124

Classification: *Sclerodermataceae, Boletales, Agaricomycetes, Agaricomycotina, Basidiomycota*, *Fungi*

The gasteroid and monotypic genus *Chlorogaster* has been classified under *Sclerodermataceae* Corda due to the presence of paracapillitium, the unique structure of the immature gleba, the characteristic morphology of its basidiospores, and the tough nature of the peridium (Kirk et al. 2001, Læssøe & Jalink 2004). This distinct dark green genus was first discovered in the lowland dipterocarp forests in eastern Sabah, Borneo (Malaysia), and hence, the name of the type and the only species, *Chlorogaster dipterocarpi* Læssøe & Jalink. The presence of dehiscent conical warts and pale green annular peristome with a simple aperture makes *Chlorogaster* quite distinguishable in the field. Another characteristic feature is the exoperidium comprising irregular angular or isodiametric to rectangular elements, separated from the hyphal endoperidium. The basidiospores are strikingly spinulose ornamented (Læssøe & Jalink 2004).

The first photograph of this genus was published in the journal Svampe (Læssøe 1999, Læssøe & Jalink 2004). However, due to its unique morphological characteristics, the genus could

not be assigned to any genus within *Sclerodermataceae*. Læssøe & Jalink (2004) described it as a novel genus with only one species, based solely on morphology. As reported in their work, DNA extraction and amplification failed in *Chlorogaster* after repeated attempts, and thus phylogenetic analysis could not be undertaken (Læssøe & Jalink 2004). Despite that, Læssøe & Jalink (2004) suggested that *Chlorogaster* is closely related to the *Colostoma/Pisolithus/Scleroderma* lineage (Hughey et al. 2000) within the *Boletales* clade (Hibbett et al. 1997) of this family, based on distinctive morphological features.

Chlorogaster dipterocarpi is ectotrophic, growing in heavy soil in association with dipterocarps (Læssøe & Jalink 2004). The gasterocarp is epigeous, pear-shaped with a broad apex and a slender pseudostipe covered with angular warts whose remnants leave scars in a reticulate pattern surrounded by low warts or ridges. The basidiospores are globose to subglobose and surrounded by a solid sheath when immature. The ornamentation is composed of undulating to slightly curved spines or crests. There is an absence of clamp connections in all hyphae (Læssøe & Jalink 2004). No molecular data documentation of *Chlorogaster* has been reported. The classification of *Chlorogaster* in *Sclerodermataceae, Boletales, Agaricomycetidae, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* is in agreement in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Type species: *Chlorogaster dipterocarpi* Læssøe & Jalink

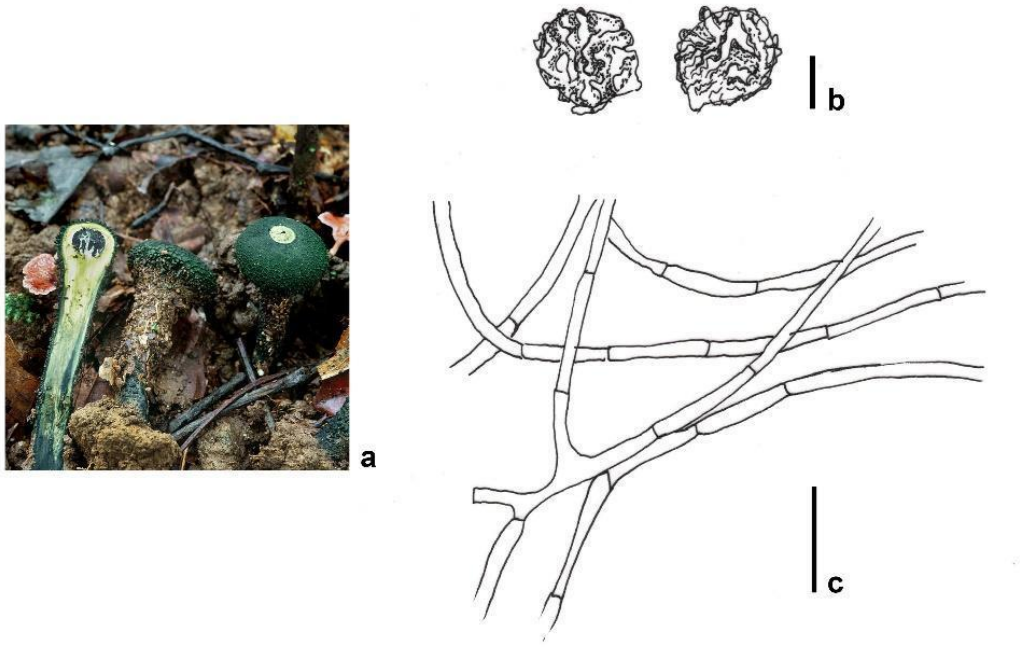


Fig. 124 – ***Chlorogaster dipterocarpi***. a Basidiomata. b Basidiospores. c Paracapillitium. Scale bars: b = 10 µm, c = 20 µm. a. source: https://redlist.info/iucn/species_view/369490/ b & c. Redrawn from Læssøe & Jalink (2004). The photo has been used under the CC BY 4.0 International non-commercial license.

Suillaceae Besl & Bresinsky, Plant Systematics and Evolution 206(1–4), 239

Species Fungorum, Facesoffungi, MycoBank, GenBank

Classification: *Boletales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Suillaceae is a small family established by H. Besl & A. Bresinsky with *Suillus* Gray as the type genus (Besl & Bresinsky 1997). Besl & Bresinsky (1997) conducted chemo-systematic analyses (pigments) of closely related genera in *Boletales*, but found *Suillus* to be distinct from others. *Suillaceae* comprises three genera: *Psiloboletinus* Singer, *Suillus*, and *Truncocolumella* Zeller (He et al. 2024, Hyde et al. 2024a). The family is widely distributed in the Northern

Hemisphere and forms ectomycorrhizal associations with roots of *Pinaceae* (He et al. 2019). Some species are considered edible (*Suillus acidus* (Peck) Singer) and medicinal (*Suillus bovinus* (L.) Roussel) (He et al. 2019).

Truncocolumella Zeller, Mycologia 31(1), 6

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 125

Classification: *Suillaceae, Boletales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Truncocolumella is a small genus of false truffles, established by Zeller in 1939, with *T. citrina* Zeller designated as its type species (Zeller 1939). The genus is characterised by the following features: basidiomata are depressed-spheroid to reniform, originating from a rhizomorphic base with a central point of attachment; the columella is prominent, varying from stump-like to dendroid; the peridium is persistent and does not separate from the gleba; the gleba is pale white when immature and turns brown upon maturity; spores are smooth, ellipsoid, and nearly hyaline when observed individually (Li et al. 2024b). Another species, *Truncocolumella rubra*, was described in the same publication and later recombined as *Gastroboletus ruber* (Zeller) Cázares & Trappe (Cázares & Trappe 1991). A third species, *T. occidentalis* (Malençon) Malençon & Zeller, was reclassified from *Dodgea occidentalis* Malençon (Malençon & Zeller 1940). Subsequently, *T. citrina* var. *citrina* Zeller and *T. citrina* var. *separabilis* A.H. Sm. were synonymised with *T. citrina* (Smith & Singer 1959). Currently, only three species are recognised: *T. citrina*, *T. occidentalis*, and *T. pseudocolumella* (Zeller 1939, Malençon & Zeller 1940, Li et al. 2024b).

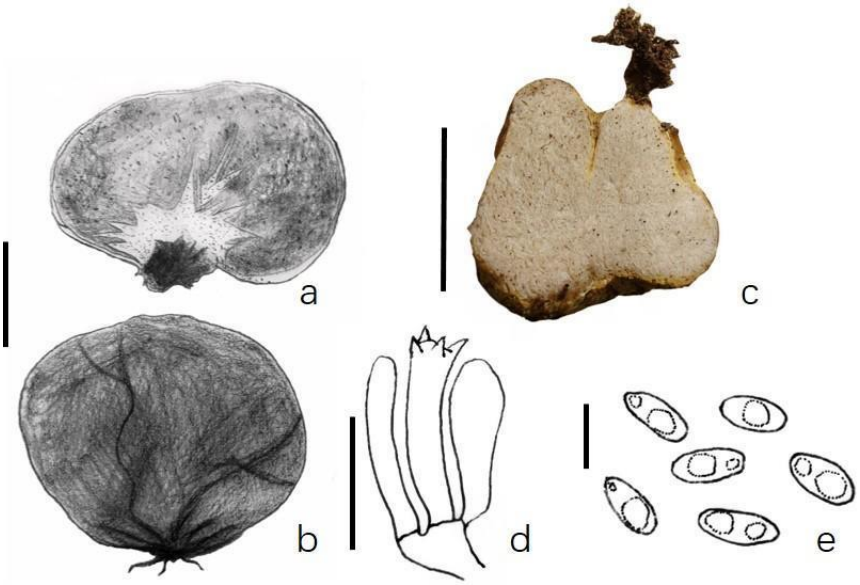


Fig. 125 – ***Truncocolumella citrina*** (a, b), ***T. pseudocolumella*** (c–e). a Gleba section. b Basidiomata surface. c Gleba section. d Hymenophore and basidia. e Basidiospores. Scale bars: a, b = 1 cm, c = 1 cm, d = 20 μm, e = 10 μm. Redrawn from Zeller (1939) and Li et al. (2024b). The photo has been used under the CC BY 4.0 International non-commercial license.

Truncocolumella citrina is a common ectomycorrhizal species widely distributed in coniferous forests of North America (Zeller 1939, Smith & Singer 1959, Goodman et al. 1998, Wood et al. 1998, Massicotte et al. 2000, Binder & Hibbett 2006, Twieg et al. 2007, Sato & Toju 2019). *Truncocolumella occidentalis* is rare and has only been reported from Canada. Its description is based on a holotype specimen preserved in alcohol for 17 years (Malençon & Zeller 1940), and no additional records of the species have been documented since its original description. Molecular data for *T. occidentalis* remains unavailable. Recently, Li et al. (2024b) reported *T. pseudocolumella* based on three specimens collected from Sichuan Province, China. Both

molecular data (ITS) and morphological characteristics support its placement within *Truncocolumella*. The classification of *Truncocolumella* in Species Fungorum, MycoBank, UNITE, and Hyde et al. (2024a) is under *Suillaceae*, whereas GenBank lists it under *Truncocolumellaceae* and may need updating.

Synonymy: *Dodgea* Malençon

Type species: *Truncocolumella citrina* Zeller

Other accepted species:

T. occidentalis (Malençon) Malençon & Zeller

T. pseudocolumella L. Li, S.H. Li & Y. Wang

Tapinellaceae C. Hahn in Hahn & Agerer, Sendtnera 6, 122

Species Fungorum, Facesoffungi, MycoBank, GenBank

Classification: *Boletales, Agaricomycetes, Agaricomycotina, Basidiomycota*, *Fungi*

Tapinellaceae is a small family established by C. Hahn & R. Agerer in 1999, with *Tapinella* E.J. Gilbert as the type genus (Hahn & Agerer 1999b). The family consists of lamellate, resupinate or effused-reflexed, and polypore-like basidiomata and is characterised by a lamelliform hymenium, bifurcated or anastomotic and decurrent lamellae, and smooth, elliptical basidiospores (Hahn & Agerer 1999b, He et al. 2024). He et al. (2024) and Hyde et al. (2024a) reported three genera in this family: *Bondarcevomyces* Parmasto, *Pseudomerulius* Jülich, and *Tapinella*. Members of *Tapinellaceae* are widely distributed, primarily in Asia (He et al. 2019). Some species are considered medicinal, including *Pseudomerulius aureus* (Fr.) Jülich (Dai & Yang 2008, He et al. 2019).

Bondarcevomyces Parmasto, in Parmasto & Parmasto, Mycotaxon 70, 219

Species Fungorum, Facesoffungi, MycoBank Fig. 126

Classification: *Tapinellaceae, Boletales, Agaricomycetes, Agaricomycotina, Basidiomycota*, *Fungi*

Bondarcevomyces, a member of *Tapinellaceae* C. Hahn, is a monotypic genus consisting of only *B. taxi* (Bondartsev) Parmasto (Kalichman et al. 2020, Wijayawardene et al. 2022). Initially identified as *Polyporus taxi* Bondartsev, this species underwent subsequent transfers to various genera: *Hapalopilus* P. Karst., *Tyromyces* P. Karst., and *Parmastomyces* Kotl. & Pouzar before becoming the type species of *Bondarcevomyces* established by Parmasto & Parmasto (1999). Parmasto & Parmasto (1999) named this genus after a Russian botanist and the wife of mycologist Apollinary Bondartsev, Margarita Appollinarievna Bondartseva. *Bondarcevomyce* causes brown rot of wood. The genus is characterised by its annual, sessile, dimidiate, and flabellate basidiomata (Parmasto & Parmasto 1999). The texture is somewhat spongy but brittle on drying. *Bondarcevomyces* has a very strong sweet odour. Bruising causes some colour changes in various aspects of the pileus. For instance, the context initially orangish turns olivaceous or dark greenish; melon-yellow or pale orange tubes shift to honey yellow or olive-green hues; and the pore surface changes from orange to saffron yellow to olive. The pigments of this genus are quite different from those of the closely related *Hapalopilus,* which makes it an identifying character for this genus. Other characters, such as monomitic hyphae, the presence of gloeoplerous hyphae, the absence of any cystidia, and ellipsoidal basidiospores with thickened, yellowish or brownish dextrinoid walls, make it unique among polypore fungi (Parmasto & Parmasto 1999).

Bondarcevomyces taxi has been found growing on dead logs of *Taxus baccata* and *Chamaecyparis formosensis* (Kiyashko & Svetasheva 2019). The pileus colour ranges from orange-red, brownish orange to yellowish brown, turning rust brown or tomato red on maturity, having a floccose to sometimes indistinctly zonate surface. The context is thick and vaguely zonate or azonate. The generative hyphae that rarely branch with anastomoses are encrusted with yellowish pigments in the context. Thin-walled, rarely clamped gloeoplerous hyphae are found abundant in the tubes having olivaceous yellow content. Basidiospores are ellipsoid, dextrinoid with one to many guttules (Parmasto & Parmasto 1999). This species has been documented mostly from

montane old-growth forests in scattered localities of Eurasia (Kiyashko & Svetasheva 2019). However, their habitats have declined substantially, posing a threat to their existence. Currently, the species is documented in only nine specific locations. Based on its potential habitat, *Bondarcevomyces taxi* is considered vulnerable according to the IUCN Red List of Threatened Species 2019 (Kiyashko & Svetasheva 2019). No molecular data on this genus is available. The classification of *Bondarcevomyces* in *Tapinellaceae, Boletales, Agaricomycetes, Agaricomycotina,* and *Basidiomycota* agrees in Index Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Type species: *Bondarcevomyces taxi* (Bondartsev) Parmasto

Basionym: *Hapalopilus taxi* Bondartsev

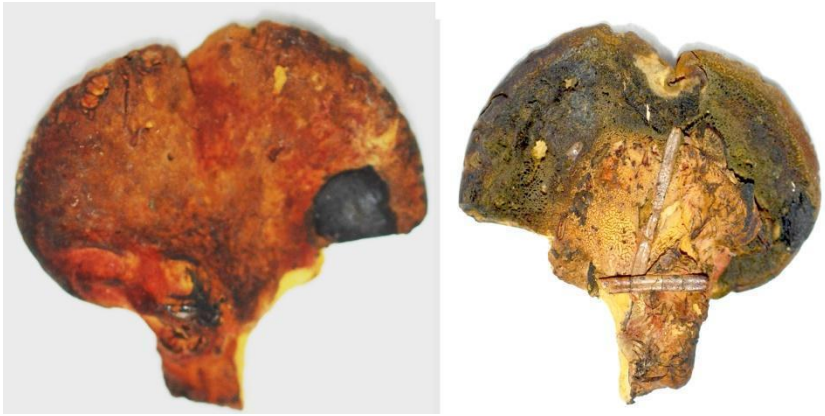


Fig. 126 – ***Bondarcevomyces taxi***. Source: https://redlist.info/iucn/species_view/450666/. The photo has been used under the CC BY 4.0 International non-commercial license.

Hymenochaetales Oberw., in Frey, Hurka & Oberwinkler, Beiträge zur Biologie der Pflanzen, 89

Species Fungorum, Facesoffungi, MycoBank, GenBank

Hymenochaetaceae Donk, Bulletin du Jardin Botanique de Buitenzorg, Série 3, 17(4), 474

Species Fungorum, Facesoffungi, MycoBank, GenBank

Classification: *Hymenochaetales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Hymenochaetaceae was established by M.A. Donk (1948), with *Hymenochaete* Lév. as the type genus (Donk 1948). Hyde et al. (2024a) recognised 52 genera worldwide in this family. The family is characterised by annual to perennial, resupinate, effused-reflexed, pileate to stipitate, and brownish basidiomata, with poroid or corticioid hymenophore, a xanthochroic reaction in KOH, and presence or absence of setoid elements (Wu et al. 2022). *Hymenochaetaceae* are distributed worldwide and are saprophytic, causing white rot (Hyde et al. 2024a). Species within the family, including *Fomitiporella* Murrill, *Porodaedalea* Murrill, *Pyrrhoderma* Imazeki, and *Sanghuangporus* Sheng H. Wu, L.W. Zhou & Y.C. Dai, are ecologically and economically important (Wu et al. 2022, Hyde et al. 2024a, Zhao et al. 2024).

Asterodon *Pat.,* Bulletin de la Société Mycologique de France 10(3), 130

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 127

Classification: *Hymenochaetaceae, Hymenochaetales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Asterodon is a hydnoid genus established by Patouillard in 1894 with the type species *A. ferruginosum* (Wagner & Fischer 2002a). *Asterodon* was previously classified in *Hymenochaetaceae* (Wang et al. 2023). Members of this genus usually grow on rotten coniferous wood and are widespread in the northern temperate region (Corner 1948, Pegler & Young 1993, He et al. 2019). *Asterodon* is distinctive by the epixylous, perennial, wholly resupinate, widely effused, separable, and umber to fulvous shape of basidiomata (Banker 1914, Corner 1948), and produces a

setulose with reddish straight, simple (spine-like) or branched setae (branch at right angles into 3 or 4 spines) of hymenium (Banker 1914). Corfixen (1990) reported that the basidiomata usually bear mycelial setae, followed by more or less branched solitary tramal setae and finally hymenial setae. Pegler and Young (1993) reported that the asterosetae of *Asterodon* are never dextrinoid, dimitic with generative hyphae simple-septate, hyaline to pale brown, and skeletal hyphae unbranched, or rarely bifurcate, aseptate, smooth, brownish ochraceous, and thick-walled in the hyphal system. Basidia are clavate with four sterigmata and simple-septate at the base (Gorjon 2020). Basidiospores are hyaline, broadly ellipsoid, aguttate, and smooth (Banker 1914). To identify *Asterodon* species, a combined morphological and phylogenetic analysis (ITS and LSU) was performed. Once, *Asterodon* was transferred from *Hymenochaetaceae* to *Asterodontaceae* based on its distinct morphological characteristics (Wang et al. 2023). However, later phylogenetic analyses again placed *Asterodon* in *Hymenochaetaceae* (Larsson 2007, Wang et al. 2023). *Asterodon* is related to *Hymenochaete* but differs mainly in the branched asterosetae (Gorjon 2020). Further study is required with non-European specimens (Fiasson & Niemela 1984). The classification of *Asterodon* in *Hymenochaetaceae, Hymenochaetales, Agaricomycetes, Agaricomycotina,* and *Basidiomycota* agrees in Index Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a). Currently, Species Fungorum (2026) lists two species of *Asterodon*.

Synonymy: *Hydnochaete* Peck, *Hydnochaetella* Sacc.

Type species: *Asterodon ferruginosus* Pat.

Other accepted species: *A. albus* Rick

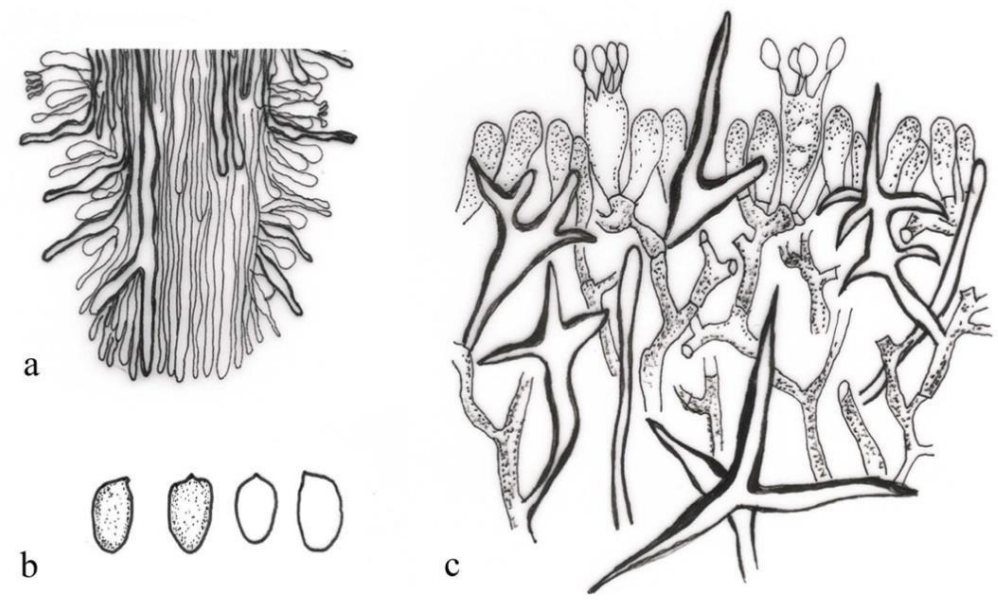


Fig. 127 – ***Asterodon ferruginosus***. a Longitudinal section of the tip of a spine. b Basidiospores. c Section of the hymenium between two spine bases. Scale bar: a, c = ×500, b = ×1000. Redrawn from Corner (1948).

Hymenochaete Lév., Annales des Sciences Naturelles, Botanique, Série 3, 5, 150

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 128

Classification: *Hymenochaetaceae, Hymenochaetales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Hymenochaete is an aphyllophoroid genus known for causing white rot in both dead and woody plants, comprising approximately 175 species globally (Hyde et al. 2024a). It is characterised by annual to perennial brown basidiomata that are resupinate to pileate, featuring a smooth corticoid hymenophore with poroid or occasionally lamellate hymenium, and always with distinct hymenial setae. The pileal surface typically cracks under dry conditions. The genus exhibits

a mono- to dimitic hyphal system, consisting of simple septate generative hyphae and skeletal hyphae, along with sterile cells on the basidiomata (Parmasto et al. 2014). Basidia are typically four-sterigmata, while basidiospores are hyaline, globose to allantoid, smooth, and thin-walled (Parmasto et al. 2014, Xw et al. 2023). A detailed identification key for East Asian and South American species was provided (Nie et al. 2017, Ryvarden & Baltazar 2022).

Although *Hymenochaete* was historically considered polyphyletic, molecular phylogenetic analyses since Wagner & Fischer have led to a clearer classification (Wagner & Fischer 2002a). *Hymenochaetaceae* Donk was split into two clades: *Hymenochaete* (with smooth hymenophores) and a smaller clade initially named *Pseudochaete* T. Wagner & M. Fisch., later renamed *Hymenochaetopsis* S.H. He & Jiao Yang (Miettinen et al. 2019). In the order-level phylogeny, *Hymenochaetaceae* is divided into two main clades: *Fomitiporia* Murrill and *Phellinus* Quél. (Miettinen et al. 2019). While Species Fungorum (2025) still lists *Dichochaete ceratophora* as a valid species, Miettinen et al. (2019) argued that *Dichochaete* Parmasto is a synonym of *Hymenochaete*, and does not merit separate generic status. These fungi are predominantly found in tropical and subtropical regions, with a limited presence in temperate zones. They are mainly associated with angiosperms, though a few occur on conifers (Parmasto et al. 2014). Multiple gene sequences (ITS, LSU, SSU, *rpb2*, and *tef-1α*) for the genus are available in the NCBI database, supporting ongoing molecular and phylogenetic studies. The classification of *Hymenochaete* in *Hymenochaetaceae, Hymenochaetales, Agaricomycetes, Agaricomycotina,* and *Basidiomycota* agrees in Index Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Synonymy: *Cerrenella* Murrill, *Cyclomyces* Kunze ex Fr., *Cyclomycetella* Murrill, *Cycloporellus* Murrill, *Dichochaete* Parmasto, *Hydnochaete* Bres., *Hymenochaetella* P. Karst., *Leptochaete* Lév., *Loxophyllum* Klotzsch, *Phaeohydnochaete* McGinty, *Stipitochaete* Ryvarden

Type species: *Hymenochaete corrugata* (Fr.) Lév.

Basionym: *Thelephora corrugata* Fr.

Other accepted species: Species Fungorum (search – *Hymenochaete*)

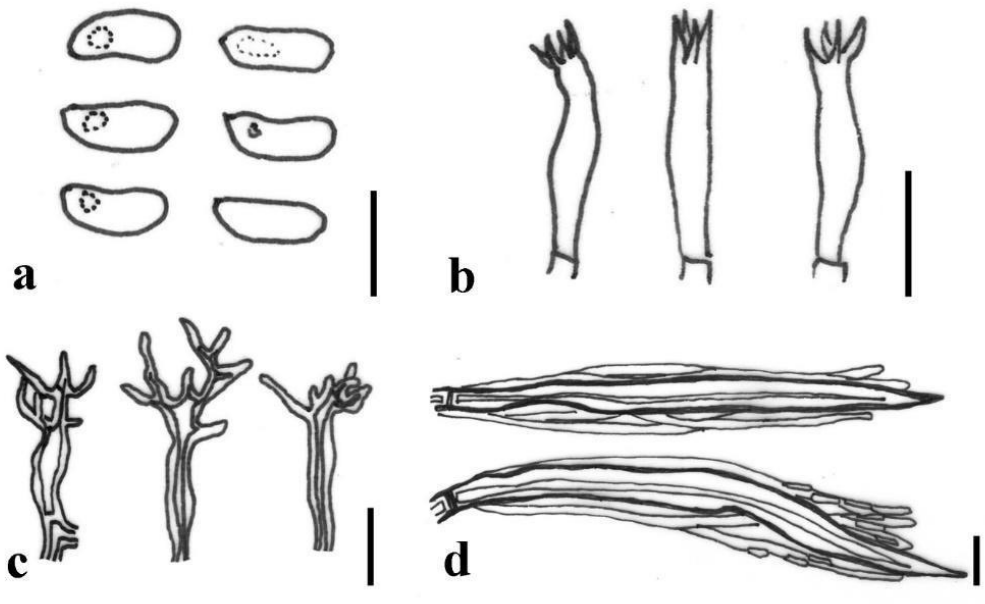


Fig. 128 – ***Hymenochaete bambusicola*** (He 4116, holotype). a Basidiospores. b Basidia. c Dendrohyphidia. d Setae. Scale bars: a = 5 µm, b–d = 10 µm. Redrawn from Nie et al. (2017). For original basidiomata, refer to Nie et al. (2017).

Inocutis Fiasson & Niemelä, Karstenia 24(1), 24

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 129

Classification: *Hymenochaetaceae*, *Hymenochaetales*, *Agaricomycetes*, *Agaricomycotina*, *Basidiomycota*, *Fungi*

Inocutis is a genus within *Hymenochaetaceae* Donk, many of which are wood-inhabiting fungi (Hibbett et al. 2014). *Inocutis rheades* (Pers.) Fiasson & Niemelä was designated as the type species of the genus (Fiasson & Niemelä 1984). Originally, *Inocutis* was included within a broad concept of *Inonotus* P. Karst, which grouped species with a monomitic hyphal system and annual basidiomata. However, Fiasson and Niemelä (1984) recognised *Inocutis* as a distinct genus based on morphological, chemical, and nuclear characteristics. Subsequent phylogenetic studies supported this taxonomic revision, justifying the recognition of *Inocutis* as a separate monophyletic lineage (Niemelä et al. 2001, Wagner & Fischer 2001, 2002b). After that, most species of *Inocutis* were reclassified from taxa formerly placed in *Inonotus* (Fiasson & Niemelä 1984, Gottlieb et al. 2002, Wagner & Fischer 2001, 2002b, Martinez 2006, Baltazar et al. 2010).

Members of *Inocutis* are characterised by annual to perennial basidiomata with a monomitic hyphal system, ellipsoid yellowish to brownish, non-dextrinoid basidiospores, and the absence of hymenial setae (Fiasson & Niemelä 1984, Wagner & Fischer 2001, 2002b, Dai & Yuan, 2005, Ghobad-Nejhad & Kotiranta 2008). Northern hemispheric species, such as *Inocutis rheades*, *I. tamaricis* (Pat.) Fiasson & Niemelä and *I. dryophila* (Berk.) Fiasson & Niemelä, exhibit a distinctive pigment pattern and a marmorated mycelial core with sclerid hyphae, a feature not observed in subtropical species such as *I. ludoviciana* (Pat.) T. Wagner & M. Fisch., and *I. jamaicensis* (Murrill) A.M. Gottlieb, J.E. Wright & Moncalvo (Drechsler-Santos et al. 2016). *Inocutis subdryophila* is the only species known to grow on conifers (Dai & Yuan 2005).

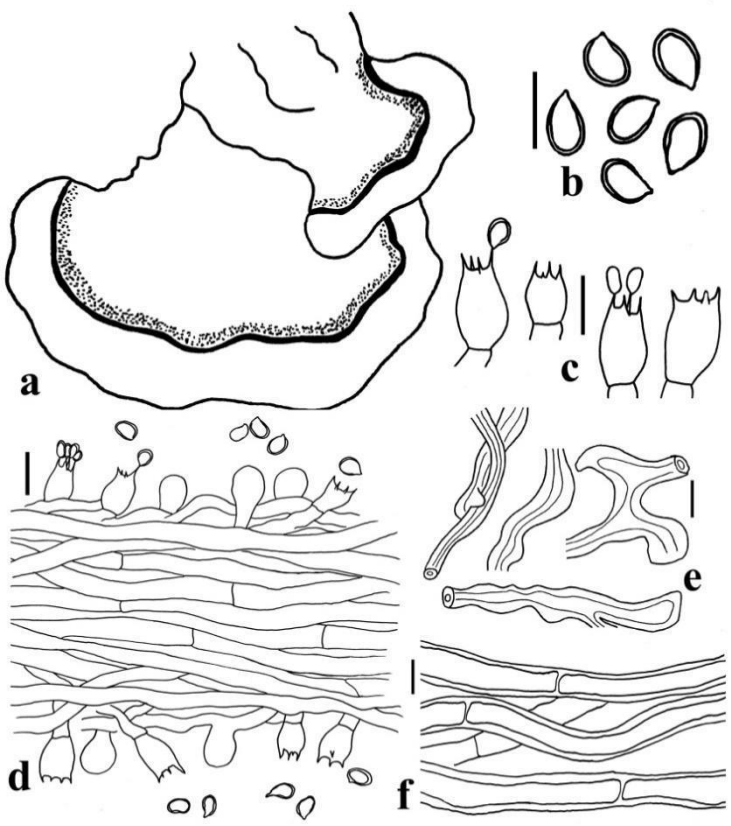


Fig. 129 – ***Inocutis rheades***. a Basidiomata. b Basidiospores. c Basidia. d Section through trama. e Skelerified hyphae from the core. f Contextual hyphae. Scale bars: a = 1 cm, b–f = 10 μm. Redrawn from Ghobad-Nejhad & Kotiranta (2008).

Recent taxonomic revision by Wu et al. (2022) expanded *Inocutis* to include three taxa previously treated in *Inonotus* that had morphological characteristics that fit *Inocutis*: *Inocutis dentata*

(Decock & Ryvarden) Y.C. Dai & F. Wu*, I. mikadoi* (Lloyd) Y.C. Dai & F. Wu, and *I. tenuicarnis* (Pegler & D.A. Reid) Y.C. Dai & F. Wu. According to Species Fungorum (2025), 12 species are recognised within the genus. The classification of *Inocutis* in *Hymenochaetaceae, Hymenochaetales, Agaricomycetes, Agaricomycotina,* and *Basidiomycota* agrees in Index Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Type species: *Inocutis rheades* (Pers.) Fiasson & Niemelä

Basionym: *Polyporus rheades* Pers.

Onnia P. Karst., Bidrag till Kännedom af Finlands Natur och Folk 48, 326

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 130

Classification: *Hymenochaetaceae, Hymenochaetales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Onnia, a wood-inhabiting fungus, was established by Karsten in 1889 with the type species *Polyporus circinatus* Fr. (*Onnia tomentosa* [Fr.] P. Karst.) (Zhao et al. 2022). Almost all species grow on gymnosperms (Germain et al. 2009, Ryvarden & Melo 2014, Zhao et al. 2022). *Onnia* is characterised by annual basidiomata that are sessile, or stipitate, with a duplex context, and bear hooked hymenial setae. The hyphal system is monomitic, characterised by simple septate generative hyphae. Basidiospores are cylindrical or ellipsoid, hyaline, thin-walled, smooth, nonamyloid, nondextrinoid, and acyanophilous (Niemelä 2005, Dai 2010, Ji et al. 2017). Both morphology and phylogeny (ITS and LSU) are used to identify *Onnia* species (Ji et al. 2017, Zhao et al. 2022).

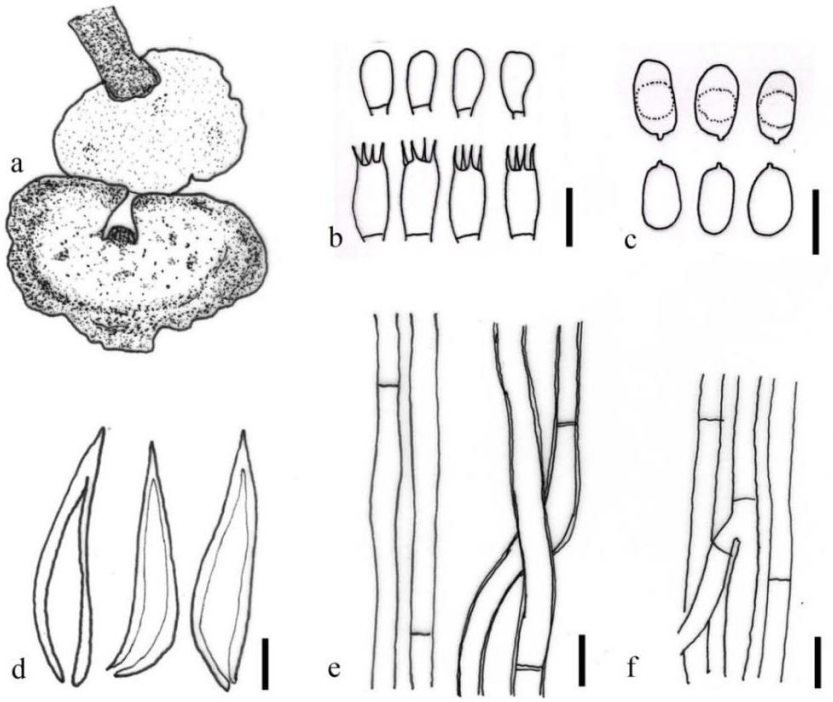


Fig. 130 – ***Onnia tomentosa***. a Basidiomata. b Basidia and Basidioles. c Basidiospores. d Setae. e Hyphae from context. f Hyphae from trama. Scale bar: a, d−f = 10 μm, c = 5 μm. Redrawn from Dai (2010).

Zhao et al. (2022) employed multiple genes (ITS, LSU, *rpb*1, *rpb*2, and *tef*-1α) to estimate divergence times using molecular clock analysis. Phylogenetically, *Onnia* is closely related to *Porodaedalea* Murill., but morphologically the latter has a perennial growth habit, pileate basidiomata lacking a stipe, dimitic hyphal system, and straight setae (Ji et al. 2017, Zhao et al. 2022). Morphologically, *Onnia* resembles *Inonotopsis* Parmasto, but the latter has resupinate basidiomata without setae (Ji et al. 2017). Some species are pathogens causing Tomentosus root rot

on *Pinaceae* trees (Germain et al. 2009, Ryvarden & Melo 2014, Zhao et al. 2022). Ethanol extracts from *Onnia tomentosa* have strong anti-proliferative activity, indicating that it is an edible and medicinal mushroom (Lee et al. 2022). The classification of *Onnia* in *Hymenochaetaceae, Hymenochaetales, Agaricomycetes, Agaricomycotina,* and *Basidiomycota* agrees in Index Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a). Currently, Species Fungorum (2026) lists 11 species of *Onnia*.

Type species: *Onnia* circinate (Fr.) P. Karst.

Basionym: *Trametes circinata* Fr.

Other accepted species: (Species Fungorum – search *Onnia*)

Phellinidium (Kotl.) Fiasson & Niemelä, Karstenia 24(1), 25

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 131

Classification: *Hymenochaetaceae, Hymenochaetales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Phellinidium was initially described as *Phellinus* subgen. *Phellinidium* Kotl. in 1968 (Kotlaba 1968). Later, it was raised to a generic level under *Hymenochaetales* Oberw., with *Phellinidium ferrugineofuscum* (P. Karst.) Fiasson & Niemelä as the type species (Fiasson & Niemelä 1984). *Phellinidium* is characterised by resupinate, inseparable basidiomata that are corky when young, becoming woody upon drying (Zhou et al. 2016b). Tissues become dark with maturity while remaining unchanged upon KOH treatment (Zhou et al. 2016b). Basidiospores are cylindrical to oblong-ellipsoidal or allantoid, hyaline, thin-walled, IKI–, CB– (Kotlaba 1968, Fiasson & Niemelä 1984, Zhou et al. 2016b). Cystidia are either present or absent, but cystidioles are absent (Zhou et al. 2016b). The hyphal system is monomitic, with generative hyphae hyaline to yellow, thin or slightly thick-walled, branched, simple-septate (Zhou et al. 2016b). The most striking feature is the presence of macrosetae, often called setoid skeletal hyphae, which predominate in both the trama and the context, usually overshadowing the true hyphae (Kotlaba 1968, Fiasson & Niemelä 1984). These hyphoid setae are abundant, dark brown, subulate, pointed, thick-walled with a narrow lumen, originating from the simple septum of yellowish, slightly thick-walled hyphae, parallel along the tubes, occasionally penetrating the hymenium, sometimes apically encrusted by small rosettes of crystals and several mm long. Hymenial setae are absent (Kotlaba 1968, Zhou et al. 2016b). The members are distributed in temperate and boreal forests of the Northern Hemisphere and are found growing on the living or decaying logs of gymnosperm, deciduous, and broad-leaved species (Zhou et al. 2016b). A culture of *Phellinidium ferrugineofuscum* has been analysed phylogenetically and shows the presence of Class II peroxidases, i.e., manganese peroxidase, associated with the degradation of humic compounds (Bödeker et al. 2009).

Based on revised taxonomical and phylogenetic studies (ITS and LSU) by Zhou et al. (2016b), the concept of *Phellinidium* was emended to accommodate only resupinate species bearing cylindrical to oblong-ellipsoid or allantoid basidiospores, and also, characteristically under the new circumscription, no species is reported to be a forest pathogen in the genus. As a result, a new genus, *Coniferiporia* L.W. Zhou & Y.C. Dai, is segregated from *Phellinidium* in *Hymenochaetaceae* Donk for the aggressive forest pathogen species. However, *Phellinidium* and *Coniferiporia* share similarities for accommodating species with resupinate basidiomata, monomitic hyphal system, abundant hyphoid setae in the subiculum and trama, and hyaline, thin-walled basidiospores, but both genera can be distinguished by the shape and size of their basidiospores. The basidiospores in *Phellinidium* are narrow, cylindrical to oblong-ellipsoidal or allantoid, whereas in *Coniferiporia* they are ellipsoid to sub-globose and comparatively wider (Zhou et al. 2016b). Also, the species of *Coniferiporia* are parasitic, while those of *Phellinidium* are saprotrophic (Zhou et al. 2016b). The classification of *Phellinidium* in *Hymenochaetaceae, Hymenochaetales, Agaricomycetidae, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* is in agreement in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a). Currently, Species Fungorum (2026) lists five species of *Phellinidium*.

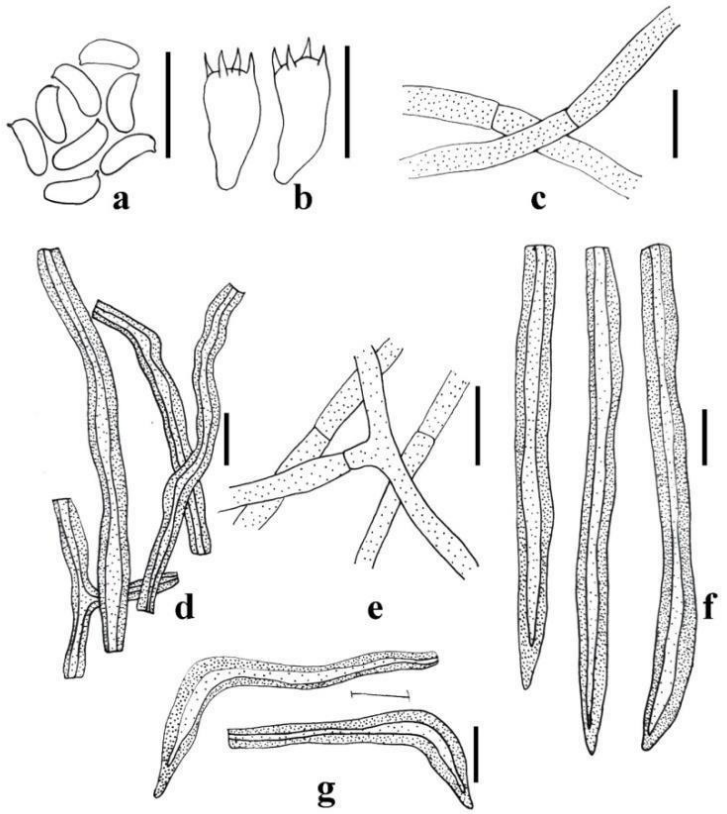


Fig. 131 – ***Phellinidium ferrugineofuscum***. a Basidiospores. b Basidia. c Thin-walled context hyphae. d Thick-walled context hyphae. e Tramal hyphae. f Setal hyphae. g Setae. Scale bars: a–g = 10 μm. Redrawn from Gilbertson (1979). For original basidiomata, refer to Zhou et al. (2016b).

Synonymy: *Phellinus* subgen. *Phellinidium* Kotl.
Type species: *Phellinidium ferrugineofuscum* (P. Karst.) Fiasson & Niemelä
Basionym: *Poria ferrugineofusca* P. Karst.
Other accepted species:
P. asiaticum Spirin, L.W. Zhou & Y.C. Dai
P. cryptocystidiatum Spirin & Zmitr.
P. pouzarii (Kotl.) Fiasson & Niemelä
P. rufitinctum (Berk. & M.A. Curtis ex A.L. Sm.) Bondartseva & S. Herrera

Phellopilus Niemelä, T. Wagner & M. Fisch., Annales Botanici Fennici 38(1), 53
Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 132
Classification: *Hymenochaetaceae, Hymenochaetales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Phellopilus is a monotypic genus established by Niemelä et al. (2001) following the re-examination of *Polyporus nigrolimitatus* Romell, which was subsequently separated into this new genus. Morphologically, *Phellopilus* is characterised by perennial, brown, poroid basidiomata with a context consisting of two distinct layers separated by a thin, crustose demarcation (Niemelä et al. 2001). It possesses a dimitic to trimitic hyphal system, comprising hyaline, septate, and branched generative hyphae, along with brown, septate, and sparsely branched skeletal-binding hyphae. The hymenium contains setae, and the dissepiment edge hyphae exhibit encrustation. Basidiospores are cylindrical to narrowly obclavate, thin-walled, smooth, faintly cyanophilous, and IKI– (Niemelä et al. 2001).

Microscopically, *Phellopilus* shares features with species of *Phellinus* Quél. and *Fuscoporia* Murrill (Niemelä et al. 2001). In *P. nigrolimitatus*, senescent hymenial cells often collapse, forming

visible honeycomb-like structures. However, its pellicular covering differs from the well-developed crust of *Phellinus igniarius* (L.) Quél. Hyphal encrustations are absent in young basidiomata but develop into a single rosette of crystals at the hyphal tips near the dissepiment edge upon maturity, unlike *Fuscoporia* and *Porodaedalea* Murrill, where numerous crystals are present on the apical segments of generative hyphae (Niemelä et al. 2001).

Interestingly, basidiospores from the lectotype specimen appear narrower than those in the holotype (Niemelä et al. 2001). A collection from Poland showed morphological similarity to a distinct species due to its long spores; however, molecular analysis confirmed its identity as *P. nigrolimitatus*, suggesting spore polymorphism within the species (Niemelä et al. 2001). *Phellopilus nigrolimitatus* has been recorded from Finland, France, Norway, Poland, and Sweden (Niemelä et al. 2001), and molecular data, including ITS, SSU, LSU, *tef-1α*, and a whole genome, are available in the NCBI database. The classification of *Phellopilus* in *Hymenochaetaceae, Hymenochaetales, Agaricomycetidae, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* is in agreement in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Type species: *Phellopilus nigrolimitatus* (Romell) Niemelä, T. Wagner & M. Fisch

Basionym: *Polyporus nigrolimitatus* Romell

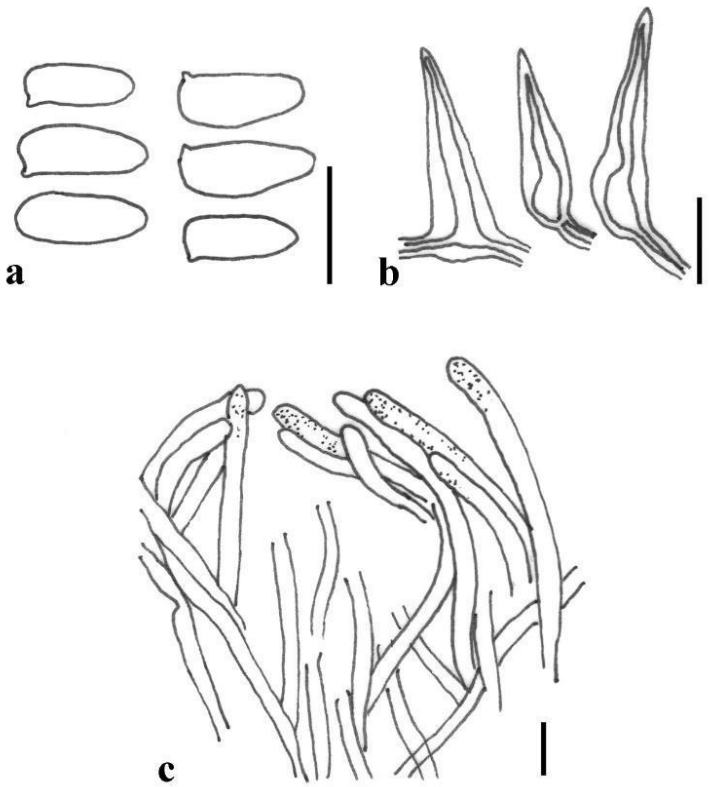


Fig. 132 – ***Phellopilus nigrolimitatus*** (a–b = Niemelä 6533 & Dai, c = Renvall 376a). a Basidiospores. b Hymenial setae. c Surface of the basidiomata of the spongy type. Scale bars: a = 5 µm, b–c = 10 µm. Redrawn from Niemelä et al. (2001). For original basidiomata, refer to Niemelä et al. (2001).

Phylloporia Murrill, Torreya 4, 141

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 133

Classification: *Hymenochaetaceae*, *Hymenochaetales*, *Agaricomycetes, Agaricomycotina*, *Basidiomycota*, *Fungi*

Phylloporia was established by Murrill (1904), with *P. parasitica* Murrill as the type species, discovered on the leaves of *Bignonia* in Colombia. It was characterized by its annual to perennial, resupinate basidiomata with a xanthochroic reaction and monomitic to dimitic hyphal system,

absence of setae, yellowish to pale brown, thick-walled basidiospores up to 5 μm length, and the unique ecological habit of growing directly on the underside of living foliage (Murrill 1904, Wagner & Ryvarden 2002, Zhou & Dai 2012, Decock et al. 2013, 2015, Gafforov et al. 2014,Liu et al. 2015,Yombiyeni et al. 2015,Zhou 2015a, 2015b, Wu et al. 2019d). The genus remained unreported until Ryvarden (1972) re-examined the type material and recognised four additional species sharing morphological characteristics with the type species. Since then, *Phylloporia* has become increasingly complex and heterogeneous. The first phylogenetic study of this genus was done by Wagner and Ryvarden (2002) using LSU sequence data, which revealed *Phylloporia* as monophyletic, closely related to *Fulvifomes* Murrill (Wu et al. 2019d). After the morphological characteristics were established (Ryvarden & Johansen 1980, Ryvarden 1991) and molecular data began to be incorporated (Wagner & Ryvarden 2002), numerous species have been documented worldwide from diverse ecological habitats (Cui et al. 2010, Valenzuela et al. 2011, Zhou & Dai 2012, Decock et al. 2013, Zhou 2013, Gafforov et al. 2014, Decock et al. 2015, Yombiyeni et al. 2015, Zhou 2015a, 2015b, Lopes et al. 2016). However, many of these studies present phylogenetic trees with several clades representing newly described species, unnamed clades, and a few taxa with uncertain placement. Although Species Fungorum (2025) currently lists 99 species, the actual number of well-characterised and accepted species is likely much lower. For instance, *Phylloporia indica* (Massee) Teixeira has been transferred to *Fulvifomes* (Zhou 2014), *P. resupinata* Douanla-Meli & Ryvarden to *Fomitiporella* Murrill clade (Decock et al. 2013). Currently, 64 species are accepted under the genus (Olou et al. 2021, Zhou et al. 2022).

Phylloporia is well known for its parasitic lifestyle, typically occurring on living stems and branches. Unlike most other members of the *Hymenochaetaceae* Donk, it does not decay its substrate but instead derives nutrients from the host sap (Wu et al. 2019d). Its pathogenicity and effects on host plants remain understudied (Ryvarden & Johansen 1980, Decock et al. 2013, Yombiyeni et al. 2015). Some species, such as *Phylloporia ribis* (Schumach.) Ryvarden, *P. parasitica* Murrill, and *P. chrysites* (Berk.) Ryvarden shows strong host specificity. Additionally, certain *Phylloporia* spp. possesses bioactive compounds with antioxidant and antitumor potential, highlighting their biotechnological relevance (Zhao et al. 2018). Members of this genus are widely distributed in the tropical areas, some reported in the temperate zone as well (Ryvarden & Johansen 1980, Gilbertson & Ryvarden 1986, 1987, Ryvarden & Gilbertson 1994, Dai 2010, 2012). The classification of *Phylloporia* in *Hymenochaetaceae, Hymenochaetales, Agaricomycetidae, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* is in agreement in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Synonym: *Cryptoderma* Imazeki, *Daedaloides* Lázaro Ibiza, *Phaeolopsis* Murrill

Type species: *Phylloporia parasitica* Murrill

Other accepted species: (Species Fungorum – search *Phylloporia*)

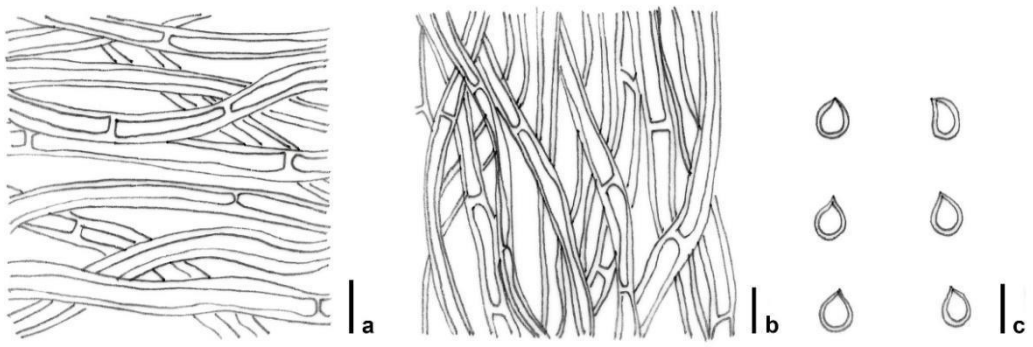


Fig. 133 – ***Phylloporia atlantica*** (URM91182). a Hyphae from lower hard context. b Hyphae from the tube trama. c Basidiospores. Scale bar: a = 5 μm, b, c =10 μm. Redrawn from Wu et al. (2019d).

Poriodontia Parmasto, Mycotaxon 14(1), 103

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 134

Classification: *Hymenochaetaceae, Hymenochaetales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

The monotypic genus, *Poriodontia*, was established by E. Parmasto in 1982 and classified under *Corticiaceae* Herter, with its type species *P. subvinosa* Parmasto (Parmasto 1982). However, recent classifications place the genus within *Schizoporaceae* Jülich (He et al. 2019). *Poriodontia* grows on fallen and rotten logs of *Picea ajanensis*, *Abies nephrolepis,* and *Tilia amurensis* (Parmasto 1982) in Russia and China (Parmasto 1982, Miettinen & Larsson 2011, Dai 2012).

Poriodontia is characterised by its resupinate basidiomata, vividly coloured, dense cottony texture, ease of separation from the substrate, arachnoid margin, and absence of rhizomorphs. The basidiospore-producing surface is poroid, with round-angular or labyrinthiform pores. The tube trama and subiculum have a similar texture. Microscopically, basidiospores are small, ellipsoidal, non-amyloid, and non-dextrinoid. The cystidia are cylindrical or subfusoid, moderately thick-walled, and apically incrustated, while gloeocystidia are absent. The genus has a monomitic hyphal system which is non-amyloid, non-dextrinoid, branched, acyanophilous, and clamped (Parmasto 1982).

The molecular phylogeny of the genus has been carried out using ITS and LSU markers (Miettinen & Larsson 2011, Zhao et al. 2015). *Trichaptum* Murrill is phylogenetically related to *Poriodontia* and shares the same clade Hymenochaetales Oberw. (Miettinen & Larsson 2011). However, they differ in both macro- and micro-morphology, with *Trichaptum* exhibiting pileate basidiomata, variable hymenophore (irpicoid, lamellate or poroid), and a mainly dimitic hyphal system (Dai et al. 2009, Zhou et al. 2023b).

The classification of *Poriodontia* in He et al. (2024) and Hyde et al. (2024a) is under *Hymenochaetaceae*, whereas Species Fungorum, GenBank, MycoBank, and UNITE list it under *Schizoporaceae* and may need updating.

Type species: *Poriodontia subvinosa* Parmasto

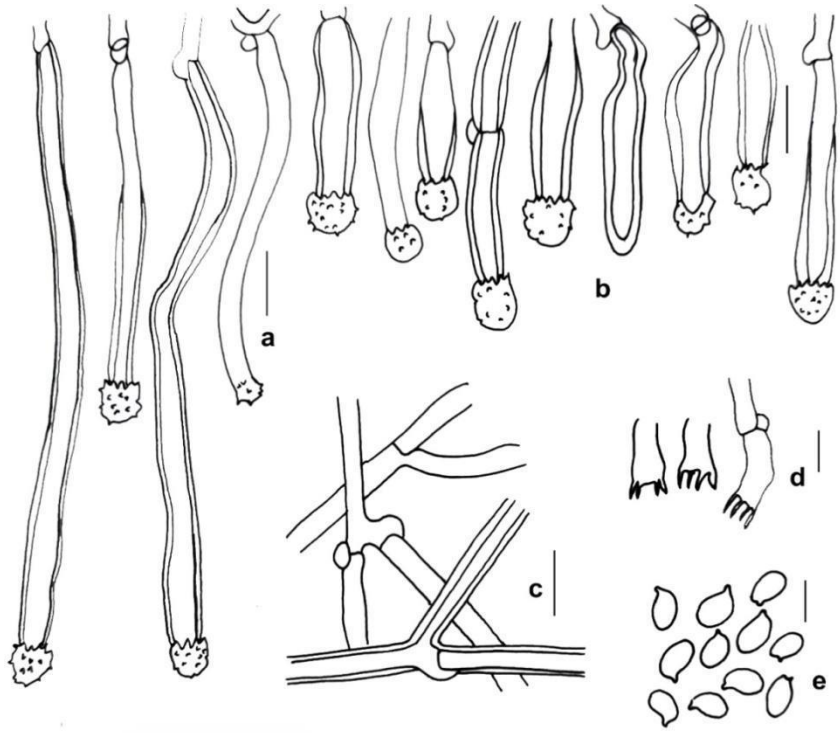


Fig. 134 – ***Poriodontia subvinosa*** (holotype). a Cystidia of the edges of pore dissepiments. b Hymenial cystidia. c Hyphae of subiculum. d Basidia. e Basidiospores. Scale bars: a–e = 10 μm. Redrawn from Parmasto (1982). For original basidiomata, refer to GBIF (2024).

Pyrrhoderma Imazeki, Transactions of the Mycological Society of Japan 7, 4

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 135

Classification: *Hymenochaetaceae*, *Hymenochaetales*, *Agaricomycetes*, *Agaricomycotina*, *Basidiomycota*, *Fungi*

Pyrrhoderma was established by Imazeki in 1966 to include two species, *P. adamantinum* (Berk.) Imazeki and *P. sendaiense* (Yasuda) Imazeki, the latter designated as the type species. This type species had been considered synonymous with *P. adamantinum* in previous literature (Dai 2010, Zhou et al. 2018a). However, these two taxa are now recognised as distinct species, differing in basidiomata morphology, basidiospore dimensions, geographical distribution, and host preferences (Hattori et al. 2024).

Pyrrhoderma is a highly diverse, small genus of wood-inhabiting fungi, with most of its species distributed in tropical regions (Zhou et al. 2018a, Wu et al. 2022). These fungi are commonly found on angiosperm wood, where they decompose lignin and cellulose, causing white rot (Imazeki 1966, Dai 2010, Zhou et al. 2018a). Among the species within this genus, *P. noxius* is an important plant pathogen responsible for brown root rot disease. This pathogen affects a broad range of host plants and is widely distributed in subtropical and tropical regions worldwide, posing significant ecological and agricultural challenges (Zhou et al. 2018a, Thambugala et al. 2023).

Pyrrhoderma is characterised by a pileus covered by a rigid crust formed of dark, densely agglutinated hyphae. The context is corky to woody in texture and typically yellowish-brown, often appearing brighter in colour compared to the tubes. The tubes themselves are woody to flinty, ranging from greyish-brown to dark brown. The hyphal system in the context is monomitic, though some species also have setal hyphae alongside generative hyphae. Similarly, the trama exhibits a monomitic hyphal system, which may or may not include setal hyphae, often showing high levels of agglutination. Setal hyphae, when present in the hymenial trama and context, are nearly uniform in size, with tapered or rounded tips. Additionally, the basidiospores are subglobose to ellipsoid in shape and colourless (Hattori et al. 2024).

Pyrrhoderma can be distinguished from closely related genera based on key morphological features. *Fulvoderma* Zhou & Dai differs from *Pyrrhoderma* in having yellowish-brown pileal surfaces, whereas *Pyrrhoderma* exhibits darker colours such as reddish brown, dark brown, or black and duplex context separated by a thin crust composed of non-agglutinated hyphae (Zhou et al. 2018a, Hattori et al. 2024). Additionally, *Pyrrhoderma* basidiomata can be resupinate, effused-reflexed, sessile, or laterally stipitate, while those of *Fulvoderma* are strictly sessile to laterally stipitate. Further *Inonotopsis* Parmasto. resembles *Pyrrhoderma* in having annual, resupinate basidiomata, a monomitic hyphal system, and ellipsoid, hyaline, thin-walled basidiospores (Dai 2010, Hattori et al. 2024). However, the resupinate species *P. hainanense* is distinguished by the presence of hyphoid setae, which are absent in *Inonotopsis* (Zhou et al. 2018a). Further, the hyphae of *Inonotus* species are characterised by their acuminate tips, tapering bases, and frequent swelling near the apex. In contrast, the hyphae of *Pyrrhoderma* species are predominantly cylindrical and uniform in width (Hattori et al. 2024). *Onnia* P. Karst. also shares similarities with *Pyrrhoderma* in its annual, sessile to stipitate basidiomata, monomitic hyphal system, and ellipsoid, hyaline, thin-walled basidiospores (Ji et al. 2017). However, *Onnia* species lack hyphoid setae and possess hymenial setae, whereas *Pyrrhoderma* species either lack hymenial setae or possess both hyphoid and hymenial setae (Zhou et al. 2018a).

Phylogenetically, *Pyrrhoderma* is a monophyletic genus within *Hymenochaetaceae* (Zhou et al. 2018a, Wu et al. 2022). Molecular classification of the genus is primarily based on ITS and LSU gene regions (Absalan et al. 2023). Zhou et al. (2023c) described a new species, *P. nigrum* Meng Zhou, Yuan Yuan & Vlasák, utilising morphological characteristics and phylogenetic analyses (ITS and LSU). The classification of *Pyrrhoderma* in *Hymenochaetaceae, Hymenochaetales, Agaricomycetidae, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* is in agreement in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a). Currently, Species Fungorum (2026) lists nine species of *Pyrrhoderma*.

Type species: *Pyrrhoderma sendaiense* (Yasuda) Imazeki

Basionym: *Polyporus sendaiensis* Yasuda
Other accepted species:
P. hainanense Zhou & Dai
P. lamaoense (Murrill) Zhou & Dai
P. luteofulvum (Cleland & Rodway) Dai & Wu
P. nigrum Meng Zhou, Yuan Yuan & Vlasák
P. noxium (Corner) Zhou & Dai
P. sublamaense (Lloyd) Dai & Wu
P. thailandicum Zhou & Dai
P. yunnanense Zhou & Dai

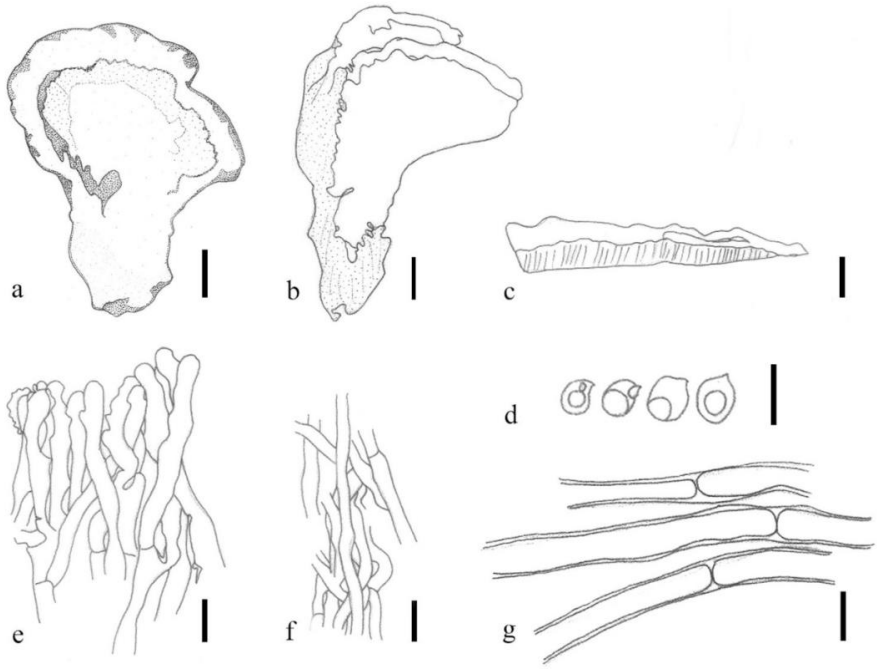


Fig. 135 – ***Pyrrhoderma sendaiense*** (KUN ZMMU 2177 and KUN ZMMU 2296). a Pileal surface. b Stipe and pore surface. c Context and tubes. d Basidiospores. e Palisade cells from the cuticle. f Hyphae from trama. g Hypae from context. Scale bars: a–c = 1 cm, d–g = 10 µm. Redrawn from Ilya & Lyudmila (2017). For original basidiomata, refer to Ilya & Lyudmila (2017).

Nigrofomitaceae Jülich, Bibliotheca Mycologica 85, 381
Species Fungorum, Facesoffungi, MycoBank, GenBank
Classification: *Hymenochaetales*, *Agaricomycetes, Agaricomycotina, Basidiomycota*, *Fungi*

Nigrofomitaceae was established by Jülich in 1981 in the order *Hymenochaetales* Oberw. (Jülich 1981, Zhou et al. 2018b). Initially, the members of this family were treated under *Polyporales* and lacked molecular evidence (Zhou et al. 2018b). The family comprises only one genus, *Nigrofomes* Murrill (Wijayawardene et al. 2022, Hyde et al. 2024a). However, He et al. (2024) synonymised this family with *Hymenochaetaceae* Donk, based on recent phylogenetic analysis. Members of *Nigrofomes* are pantropical in distribution (Zhou et al. 2018b).

Nigrofomes Murrill, Bulletin of the Torrey Botanical Club 31(8), 425
Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 136
Classification: *Nigrofomitaceae*, *Hymenochaetales*, *Agaricomycetes, Agaricomycotina, Basidiomycota*, *Fungi*

Nigrofomes is a wood-decaying genus that was once classified under *Polyporaceae* Fr. ex Corda, but recent molecular studies suggest it belongs to a separate family, *Nigrofomitaceae* Jülich (Jülich 1981). The genus was established by Murrill (1904) based on a single species, *Nigrofomes*

melanoporus (Mont.) Murrill, from Cuba. *Nigrofomes* was long considered a monotypic genus until *N. nigrivineus* (Corner) T. Hatt. & Sotome, originally described as *Trametes nigrivinea* Corner from Papua New Guinea, was proposed as a new combination (Corner 1989). However, this species was later moved to a different genus, *Nigrohirschioporus* Y.C. Dai, Yuan Yuan & M. Zhou (Zhou et al. 2023d). Two other species, *Nigrofomes sinomelanoporus* L.W. Zhou and *N. submelanoporus* M. Zhou, F. Wu & X.M. Tian were added from China (Zhou et al. 2018b, 2020a), so the genus now has three recognised species.

The origin of the "*Nigrofomes*" name is a combination of the Latin word *niger* (black) with the name *Fomes* (Donk 1960). The genus is characterised by perennial, woody, tough, sessile basidiomata that form a large hymenophore (Murrill 1904). The outer surface is usually dark brown to black, but the interior context is purple, which is the key identifying feature of *Nigrofomes*. The pore surface darkens with age, with black tubes that are typically stratified, indicating perennial growth. Microscopically, *Nigrofomes* has a dimitic hyphal system with generative hyphae having clamp connections and thick-walled skeletal hyphae (Murrill 1904). The basidiospores are hyaline, smooth, cylindrical to ellipsoid, and non-amyloid, and cystidia are generally absent. Among the recognised species, *Nigrofomes melanoporus* is the type species. The family *Nigrofomitaceae* was established to accommodate *Nigrofomes* (Jülich 1981), but for a long time was treated as a synonym of *Polyporaceae* (Kirk et al. 2008, Ryvarden 2015). However, Zhou et al. (2018b) confirmed *Nigrofomitaceae* to belong to *Hymenochaetales* Oberw. rather than *Polyporales* through phylogenetic analysis. Their study also affirmed the position of *Nigrofomes* under *Nigrofomitaceae*. The genus has a pantropical distribution, with reports from Asia, Africa, Central and South America, and various Pacific islands. The classification of *Nigrofomes* in Species Fungorum, GenBank, UNITE, and Hyde et al. (2024a) is under *Nigrofomitaceae*, whereas MycoBank lists it under *Polyporaceae* and may need updating. Currently, Species Fungorum (2026) lists three species of *Nigrofomes*.

Synonyms: *Melanoporella* Murrill, *Melanoporia* Murrill

Type species: *Nigrofomes melanoporus* (Mont.) Murrill

Other accepted species:

N. sinomelanoporus L.W. Zhou

N. submelanoporus M. Zhou, F. Wu & X.M. Tian

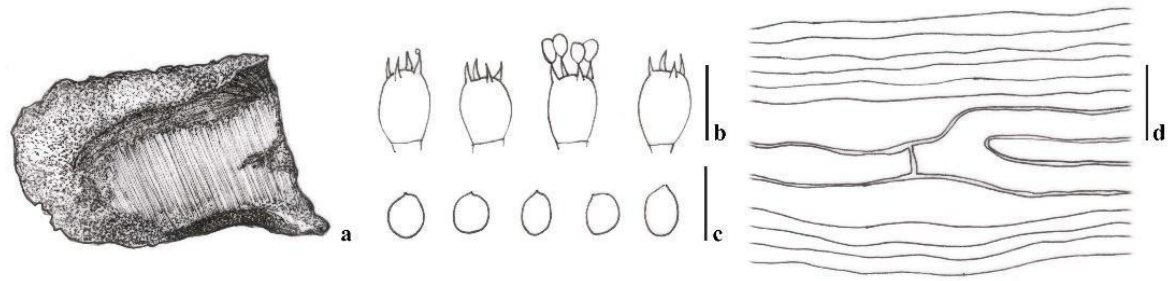


Fig. 136 – ***Nigrofomes sinomelanoporus*** (Dai 16286). a Vertical section of the basidiomata. b Basidia. c Basidiospores. d Hyphae from context. Scale bar: b–d = 10 μm. Redrawn from Zhou et al. (2018b).

Rickenellaceae Vizzini, Micologia e Vegetazione Mediterranea 25(2), 144

Species Fungorum, Facesoffungi, MycoBank, GenBank

Classification: *Hymenochaetales, Agaricomycetes, Agaricomycotina, Basidiomycota*, *Fungi*

Rickenellaceae was established by Vizzini in 2010, with the type genus *Rickenella* Raithelh (Vizzini 2010). The family includes two genera: *Atheloderma* Parmasto and *Rickenella* (Hyde et al. 2024a). However, He et al. (2024), based on molecular analyses, transferred all genera to other families, leaving only the type genus within the family. *Rickenellaceae* is characterised by annual,

omphalinoid basidiomata with lamellate hymenophore, central stipe, monomitic hyphal system, and having caulocystidia, cheilocystidia, pileocystidia and pleurocystidia, and narrowly lageniform to obclavate, smooth, thin-walled, hyaline, ellipsoid to cylindrical, inamyloid and acyanophilous basidiospores (Wang et al. 2023, He et al. 2024).

Atheloderma Parmasto, Conspectus Systematis Corticiacearum (Tartu), 73
Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 137

Classification: *Rickenellaceae, Hymenochaetales, Agaricomycetes, Agaricomycotina, Basidiomycota*, *Fungi*

Atheloderma was established by Parmasto in 1968 to accommodate *A. mirabile* as its type species (Parmasto 1968). Later, *Atheloderma* was treated as a subgenus of *Athelia* Pers. under family *Atheliaceae* Jülich and order *Atheliales* Jülich (Wang et al. 2023). However, Larsson et al. (2006, 2007), based on the 5.8S and LSU phylogeny, recognised *Atheloderma* as an independent genus within *Hymenochaetales* Oberw. and *Rickenellaceae* Vizzini. The genus is characterised by resupinate and membranous basidiomata, a fimbriated margin, smooth and white-coloured hymenophore, and the presence of rhizomorphs (Jülich 1972, Pérez Gorjón 2020). Basidiospores are elongated, smooth, ellipsoid, or cylindrical, inamyloid, and thin-walled (Pérez Gorjón 2020). Basidia clavate to irregular shape, clamped at base, with 4 sterigmata. Cystidia are cylindrical, projected beyond the hymenium, non-encrusted, and show the presence of clamp septa. The hyphal system is monomitic, with clamp connections (Pérez Gorjón 2020). The genus is reported from Russia and Asia (Jülich 1972, He et al. 2019). Members of this genus grow on the fallen trunk of *Juniperus communis* and hardwood bark (Jülich 1972).

The classification of *Atheloderma* in *Rickenellaceae, Hymenochaetales, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* agrees in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a). Currently, Species Fungorum (2026) lists two species of *Atheloderma*.

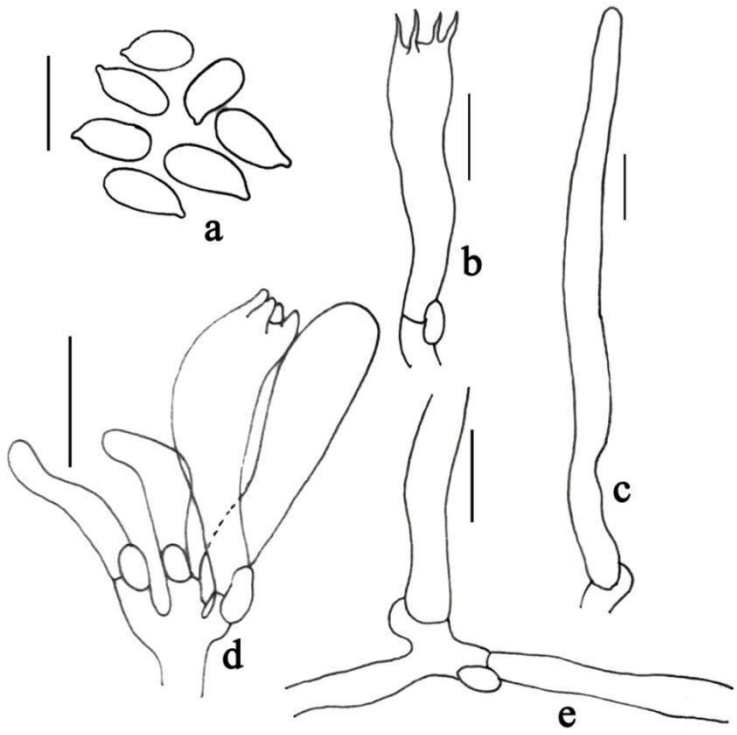


Fig. 137 – ***Atheloderma mirabile*** (holotype). a Basidiospores. b Basidia. c Cystidia. d A cluster of basidia and basidioles. e Hyphae with clamp connections. Scale bars: a–e = 10 μm. Redrawn from Singer (1962). For original basidiomata, refer to GBIF (2011).

Type species: *Atheloderma mirabile* Parmasto
Other accepted species: *A. orientale* Parmasto

Rigidoporaceae Jülich, Bibliotheca Mycologica 85, 388
Species Fungorum, Facesoffungi, MycoBank
Classification: *Hymenochaetales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Rigidoporaceae is characterised by resupinate to pileate, annual to perennial basidiomata, with tomentose to glabrous, usually zonate pileus and poroid hymenophore. Hyphal system is monomitic to dimitic with simple septate generative hyphae and thick-walled skeletal hyphae (Wang et al. 2023). Cystidia, if present, are encrusted. Basidiospores are thin-walled, ovoid to globose, inamyloid, and acyanophilous. Wang et al. (2023) resurrected *Rigidoporaceae* as the correct family name, replacing its later synonym *Oxyporaceae* Zmitr. & V. Malysheva, which was inaccurately used in Zhou et al. (2018), He et al. (2019), Wang et al. (2021). Although the *Rigidoporaceae* clade showed weak phylogenetic support and required further clarification, the earlier name based on the type genus *Rigidoporus* Murrill (Jülich 1981) has nomenclatural priority. Currently, *Rigidoporaceae* accommodates *Bridgeoporus* T.J. Volk, Burds. & Ammirati, *Leucophellinus* Bondartsev & Singer, and *Rigidoporus* (Wang et al. 2023, Hyde et al. 2024a). Other genera previously included, *Ceriporia* Donk, *Henningsia* Möller, and *Macrohyporia* I. Johans. & Ryvarden, are excluded as molecular phylogeny places them elsewhere within *Polyporales*.

Botryodontia (Hjortstam & Ryvarden) Hjortstam, Mycotaxon 28(1), 20
Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 138
Classification: *Rigidoporaceae, Hymenochaetales, Agaricomycetes, Agaricomycotina, Basidiomycota*, *Fungi*

Botryodontia (Hjortstam & Ryvarden) Hjortstam is a wood-inhabiting genus in *Rigidoporaceae*, *Hymenochaetales*. It was originally proposed as *Candelabrochaete* Boidin subgen. *Botryodontia* by Hjortstam & Ryvarden (1986) and later elevated to generic rank by Hjortstam (1987).

Basidiomata are resupinate, loosely adnate, fairly thin, and range from arachnoid to distinctly continuous, sometimes appearing tufted, and bearing small to relatively small aculei. Rhizomorphs are conspicuous. The hyphal system is monomitic or dimitic-duplex, with hyphae that are thin- to distinctly thick-walled and lacking clamp connections. Cystidia or hyphoid elements are present, either smooth or strongly encrusted. Basidia are short, obconical to short-cylindrical, equipped with four sterigmata and lacking a basal clamp. Basidiospores are subglobose, thin-walled, smooth, inamyloid, indextrinoid, and acyanophilous (Hjortstam 1987, Gorjón 2020, Ryvarden 2002). *Botryodontia* resembles several *Hyphodontia* J. Erikss species by exhibiting a colliculose to odontioid hymenophore. However, the key distinction lies in basidial morphology. In *Hyphodontia*, the basidia are large, subclavate, and typically show a median constriction, whereas in *Botryodontia* they are short and obconical (Hjortstam 1987, Gorjón 2020).

Wang et al. (2023) revised the taxonomic framework of *Hymenochaetales* using multigene phylogenetic analyses, reassessing the systematic placement of *Botryodontia*. They demonstrated that Chinese collections morphologically identified as the type species *Botryodontia cirrata* (Hjortstam & Ryvarden) Hjortstam, clustered within the clade of *Rigidoporus* Murrill. Consequently, *Botryodontia* is considered a synonym of *Rigidoporus*, with *B. cirrata* and *B. millavensis* (Bourdot & Galzin) Duhem & H. Michel being transferred to that genus, while the phylogenetic status of non-sequenced species previously assigned to *Botryodontia* remains unresolved. Hyde et al. (2024a) likewise treated *Botryodontia* as a synonym of *Rigidoporus*. Thus, most of the originally included species in *Botryodontia* are now accepted under other genera, especially *Rigidoporus* and *Hyphodontia*. Species Fungorum (2025) includes only two accepted species. However, their exact phylogenetic status is yet to be evaluated. Despite these taxonomic shifts, *Botryodontia* remains of interest for its ecological distribution and its historical treatment as a distinct genus within *Hymenochaetales*. The classification of *Botryodontia* in Hyde et al. (2024a)

is under *Rigidoporaceae*, whereas Species Fungorum and UNITE list it under *Hymenochaetaceae* and may need updating.

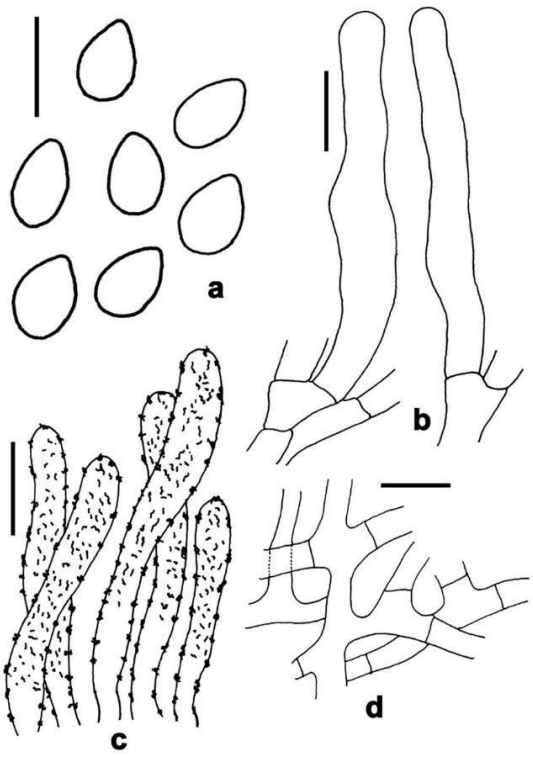


Fig. 138 – ***Botryodontia semispathulata***. a Basidiospores. b Cheilocystidia. c Encrusted hyphae from the aculei. d Hyphae from the subiculum. Scale bars: a–d = 10 μm. Redrawn from Ryvarden (2002). For original basidiomata, refer to GBIF (2025).

Synonymy: *Candelabrochaete* subgen. *Botryodontia* Hjortstam & Ryvarden
Type species: *B. millavensis* (Bourdot & Galzin) Duhem & H. Michel
Basionym: *Poria mucida* subsp. *millavensis* Bourdot & Galzin
Other accepted species:
B. semispathulata Hjortstam & Ryvarden
B. tetraspora (S.S. Rattan) Hjortstam & Ryvarden

Rigidoporus Murrill, Bulletin of the Torrey Botanical Club 32(9), 478
Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 139
Classification: *Rigidoporaceae, Hymenochaetales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Rigidoporus is one of the most ecologically important wood-decaying genera that grow on living foliage to rotten wood (Gilbertson & Ryvarden 1987, Dai 2012, Ryvarden & Melo 2014, Wu et al. 2017b). The genus was erected by Murrill (1905a) with *R. microporus* (Fr.) Overeem (=*Polyporus micromegas* Mont) as the type (Wang et al. 2023). Previously, the genus was placed in *Polyporales* Gäum., but molecular studies (ITS and LSU) revealed it to belong in the *Hymenochaetales* Oberw. (Wu et al. 2017b). The classification of *Rigidoporus* in He et al. (2024) and Hyde et al. (2024a) is under *Rigidoporaceae*, whereas Species Fungorum, MycoBank, GenBank, and UNITE list it under *Meripilaceae* and may need updating.

Rigidoporus is characterised by annual to perennial, resupinate to bracket-like, soft-corky when fresh and hard-corky when dry, reddish to dark tube layer with white to brown pore surfaces, monomitic or pseudo-dimitic hyphae, presence of hyphoid cystidia, inamyloid and indextrinoid basidiospores and hyphae (Murrill 1905a, Pouzar 1966b, Ryvarden & Melo 2017). Based on similar hyphae and basidiospores, *Rigidoporus* was often confused with *Oxyporus* (Bourdot &

Galzin) Donk (Donk 1933). *Oxyporus* was also regarded as a subgenus of *Rigidoporus*, although distinct morphological differences between the two were noted (Ryvarden & Melo 2017). Wu et al. (2017b) demarcated *Rigidoporus sensu stricto,* and *Oxyporus* was phylogenetically nested within it. On this basis, *Oxyporus* was synonymised with it. The phylogeny showed its distinctiveness from morphologically similar *Physisporinus* P. Karst. in the *Polyporales*. Likewise, another similar genera *Leucophellinus* Bondartsev & Singer and *Bridgeoporus* T.J. Volk, Burds. & Ammirati were recognised in separate clades in *Hymenochaetales* (Wu et al. 2017b). Zmitrovich & Malysheva (2014) had placed *Rigidoporus* in *Oxyporaceae* Zmitr. & Malysheva, but Wang et al. (2023) later reinstated *Rigidoporaceae* Jülich with *Oxyporaceae* as synonyms. Within *Rigidoporus,* Hyde et al. (2024a) have recognised approximately 80 species worldwide.

Rigidoporus is a cosmopolitan genus occurring on both angiosperms and gymnosperms. Some species are aggressive pathogens. For instance, *Rigidoporus microporus* causes white root disease of rubber (*Hevea brasiliensis*), a major problem in tropical plantations, leading to significant yield losses. The fungus persists in root debris and spreads via rhizomorphs. However, biological control using *Trichoderma harzianum* Rifai has shown strong antagonism to *R. microporus* (Jayasuriya & Thennakoon 2007).

Type species: *Rigidoporus microporus* (Sw.) Overeem

Synonym: *Polyporus micromegas* Mont.

Other accepted species: (Species Fungorum – search *Rigidoporus*)

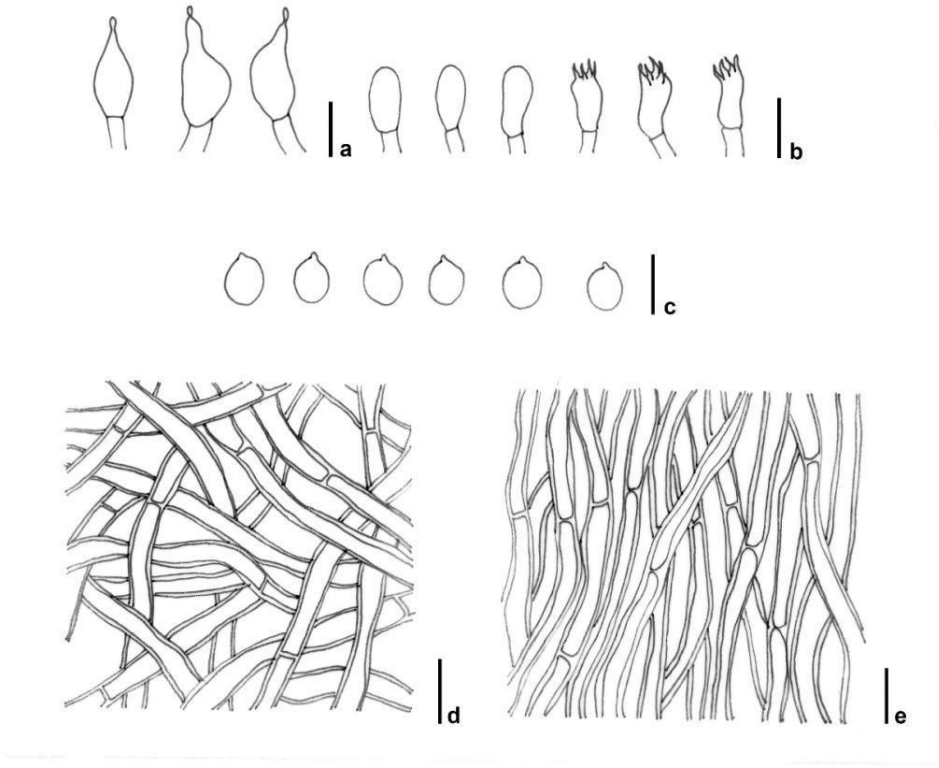


Fig. 139 – ***Rigidoporus microporus*** (Dai 17402). a Cystidioles. b Basidia and basidioles. c Basidiospores. d Hyphae from context. e Hyphae from trama. Scale bars: c = 5 μm; a, b, d & e = 10 μm. Redrawn from Wang et al. (2023).

Schizoporaceae Jülich, Bibliotheca Mycologica 85, 389

Species Fungorum, Facesoffungi, MycoBank, GenBank

Classification: *Hymenochaetales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Schizoporaceae was established by W. Jülich (1982) and typified by *Schizopora* Velen. (=*Xylodon* (Pers.) Gray) (Jülich 1982). The family consists of six genera: *Alutaceodontia*

(Parmasto) Hjortstam & Ryvarden, *Echinoporia* Ryvarden, *Fasciodontia* Yurchenko & Riebesehl, *Hyphodontia* J. Erikss., *Lyomyces* P. Karst., and *Xylodon* (Hyde et al. 2024a). *Schizoporaceae* is characterised by resupinate or pileate basidiomata, with whitish to brownish, smooth to poroid hymenophore, presence of cystidia, hyphal system monomitic to trimitic with clamps, presence or absence of cystidia, and smooth, hyaline, globose to allantoid, inamyloid, acyanophilous to slightly cyanophilous basidiospores (Wang et al. 2021, He et al. 2024). Members of the family are distributed worldwide and are saprophytic, causing white rot (He et al. 2019).

Alutaceodontia (Parmasto) Hjortstam & Ryvarden, Synopsis Fungorum (Oslo) 15, 7

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 140

Classification: *Schizoporaceae, Hymenochaetales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Alutaceodontia was introduced as the *Hyphodontia sect. Alutaceodontia* Parmasto. This monotypic genus was described based on specimens collected from gymnosperms in Sweden (Hjortstam et al. 2002). Later, it was frequently reported in Turkey by Doğan & Kurt (2016). *Alutaceodontia* has been primarily found in Europe, commonly on the bark of *Abies*, and is associated with *Auliscus albidus* (Doğan & Kurt 2016).

Alutaceodontia is characterised by resupinate basidiomata that are flat to adnate, cream-white when fresh, and turn dark yellow with age (Doğan & Kurt 2016). The hymenium exhibits a waxy, granular, or powdery-toothed texture. Its basidia are sub-clavate with basal clamp connections, while the basidiospores are allantoid, pale brown, smooth, thin-walled, and non-reactive to amyloid or dextrinoid tests (Hjortstam et al. 2002, Doğan & Kurt 2016). The hyphal system is monomitic with clamp connections (Doğan & Kurt 2016). Cystidia are found between the basidia, emerging from the subiculum or sub-hymenial layer. Molecular data for *Alutaceodontia*, including ITS, LSU, and SSU gene sequences, are available on NCBI; however, they lack authentic publications. The classification of *Alutaceodontia* in *Schizoporaceae, Hymenochaetales, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* agrees in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

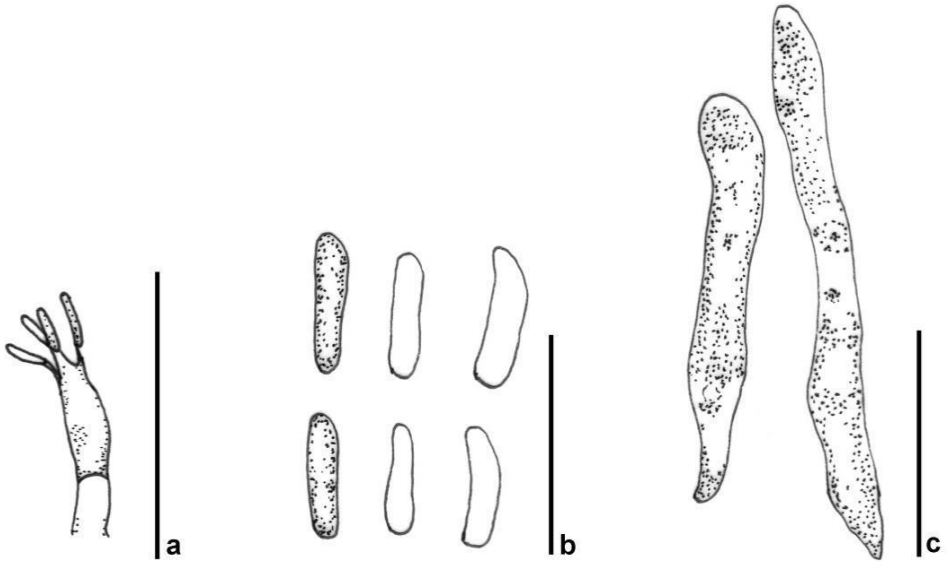


Fig. 140 – ***Alutaceodontia alutacea***. a Basidia. b Basidiospores. c Cystidia. Scale bars: a, c = 20 µm, b = 10 µm. Redrawn from Doğan & Kurt (2016). For original basidiomata, refer to GBIF (2024).

Synonym: *Hyphodontia sect. Alutaceodontia* Parmasto

Type species: *Alutaceodontia alutacea* (Fr.) Hjortstam & Ryvarden

Basionym: *Hydnum alutaceum* Fr.

Tubulicrinaceae Jülich, Bibliotheca Mycologica 85, 392

Species Fungorum, Facesoffungi, MycoBank, GenBank

Classification: *Hymenochaetales, Agaricomycetes, Agaricomycotina, Basidiomycota*, *Fungi*

Tubulicrinaceae was established by Jülich in 1981 and typified with *Tubulicrinis* Donk in *Tubulicrinales* Jülich (Jülich 1981). Later, Larsson (2007) revisited the family and placed it under *Hymenochaetales*. Recent taxonomic revisions within the order *Hymenochaetales*, as synthesized in the updated fungal classification (Hyde et al. 2024a), have resulted in the reinstatement of *Tubulicrinaceae* Jülich as a distinct family. This monotypic family encompasses annual, resupinate to effused, corticoid fungi with smooth, pruinose to porulose hymenophore (Wang et al. 2023). Microscopically, it is characterised by a monomitic hyphal system, presence of cylindrical or conical cystidia, subglobose to allantoid, smooth, thin-walled, inamyloid and acyanophilous basidiospores (Wang et al. 2023, He et al. 2024).

Tubulicrinis Donk, Fungus, Wageningen 26(1–4), 13

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 141

Classification: *Tubulicrinaceae, Hymenochaetales, Agaricomycetes, Agaricomycotina, Basidiomycota*, *Fungi*

Tubulicrinis was erected by Donk in 1956, with *T. glebulosa* (Bres.) Donk as its type species (Thind & Rattan 1970). *Tubulicrinis* species are epixylous and have widespread distribution, typically found on very rotten wood (Thind & Rattan 1970).

Tubulicrinis species are characterised by entire resupinate basidiomata that are firmly adnate, smooth, and often very thin. The hymenophore is pruinose to porulose, sometimes displaying waxy patches and an indeterminate margin (Donk 1956, He et al. 2020). Basidiomata are typically white or whitish, with a hispid or atomate surface visible under a hand lens (Donk 1956, Bernicchia & Gorjon 2010). The basidiospores are smooth, small to medium-sized, colourless, with shapes ranging from globular or curved-cylindrical to allantoid, or globose to ellipsoid, and non-amyloid, IKI-negative (both inamyloid and indextrinoid), and acyanophilous (Donk 1956, Thind & Rattan 1970, Kotiranta et al. 2007, Bernicchia & Gorjon 2010). The hyphal system is monomitic, with clamped connections on generative hyphae. The trama comprises a basal layer of narrow, thin-walled hyphae that often become agglutinated and indistinct. These hyphae produce cystidia, which are a defining feature of the genus (Thind & Rattan 1970). The cystidia (lyocystidia) are conspicuous and projecting, arising from distinct basal hyphae (often with two more roots), are often slender, cylindrical to slightly conical, very thick-walled with capillary lumens, and abruptly thin-walled towards the apex, which is pointed, capitately swollen (Donk 1956, Thind & Rattan 1970, Kotiranta et al. 2007, Bernicchia & Gorjon 2010). These structures are breakable, smooth-surfaced, and non-encrusted, though their thin-walled apices may feature loosely attached crystals or sheathing caps. The cystidia are colourless, the wall is not stained by eosin, is often more or less amyloid, and is soluble in 10% KOH (Donk 1956, Thind & Rattan 1970, Kotiranta et al. 2007, Bernicchia & Gorjon 2010).

Tubulicrinis was first placed in *Tubulicrinaceae* Jülich, which was regarded as monotypic (Larsson 2007, Wang et al. 2023). Since molecular sequences are unavailable for *T. corneri, T. hamatus,* and *T. umbraculus*, the phylogenetic relationships among these three species and other *Tubulicrinis* species are unknown (Wang & Zhou 2024). Currently, approximately 40 species are accepted in the genus worldwide (Hyde et al. 2024a). Molecular studies of *Tubulicrinis* species have been carried out based on the ITS and LSU sequences (Larsson et al. 2006, Dai 2011, Crous et al. 2016, He et al. 2020). The classification of *Tubulicrinis* in MycoBank, GenBank, He et al. (2024) and Hyde et al. (2024a) is under *Tubulicrinaceae*, whereas Species Fungorum and UNITE list it under *Hymenochaetaceae* and may need updating.

Type species: *Tubulicrinis glebulosus* (Fr.) Donk

Basionym: *Thelephora calcea* subsp. *glebulosa* Fr.

Other accepted species: (Species Fungorum – search *Tubulicrinis*)

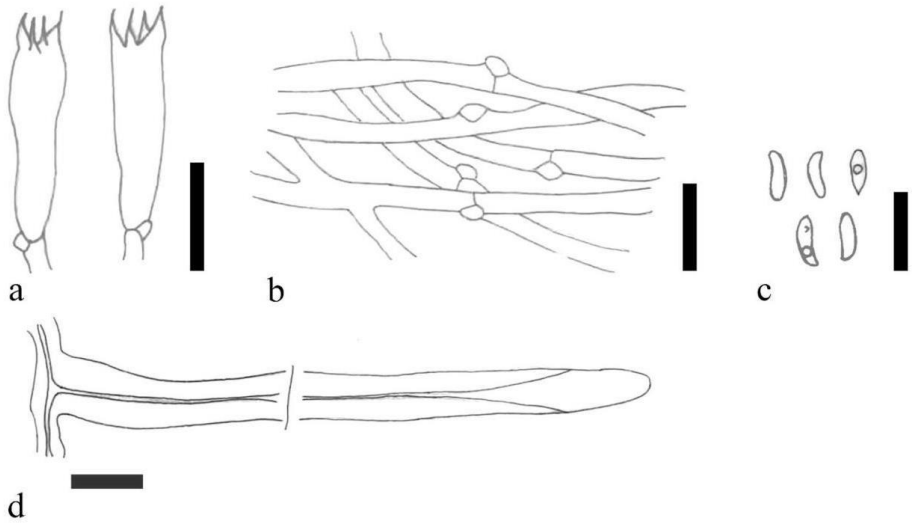


Fig. 141 – ***Tubulicrinis glebulosus***. a Basidia. b Generative hyphae. c Basidiospores. d Cystidia. Scale bars: a–d = 10 μm. Redrawn from Prasher (2015). For original basidiomata, refer to GBIF (2024).

Hymenochaetales genera incertae sedis

Cantharellopsis Kuyper, La Famiglia delle Tricholomataceae, Atti del Convegno Internazionale del 10–15 Settembre 1984, Borgo Val di Taro, Italy (Borgo Val di Taro) 6, 99

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 142

Classification: *Incertae sedis, Hymenochaetales, Agaricomycetes, Agaricomycotina, Basidiomycota*, *Fungi*

Cantharellopsis was established by Kuyper (1986) to accommodate *Cantharellus prescottii* Weinm., a species previously placed in *Gerronema* Singer and *Hygrophoropsis* (J. Schröt.) Maire ex Martin-Sans (Redhead et al. 2002). It is a monotypic genus, with *Cantharellopsis prescottii* as the type species. Molecular phylogenetic analyses confirmed its placement within the agaricoid *Hymenochaetales*, distinct from *Agaricales* where *Gerronema* resides (Redhead et al. 2002). The classification of *Cantharellopsis* in Species Fungorum, UNITE, and Hyde et al. (2024a) is under *incertae sedis*, whereas MycoBank and GenBank list it under *Rickenellaceae* and may need updating.

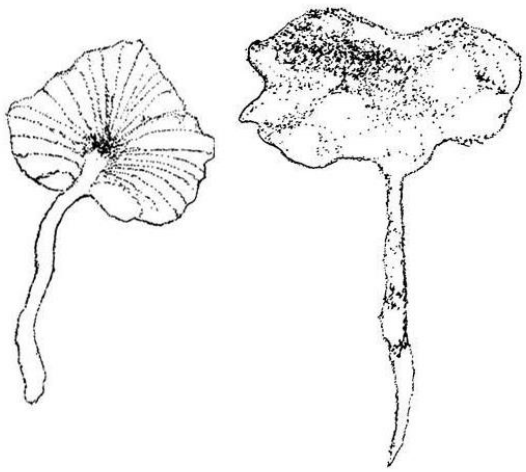


Fig. 142 – ***Cantharellopsis prescotii***. Redrawn from Henrici (2022). For original basidiomata, refer to Henrici (2022).

Contumyces Redhead, Moncalvo, Vilgalys & Lutzoni, Mycotaxon 82, 161

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 143

Classification: *Incertae sedis, Hymenochaetales, Agaricomycetes, Agaricomycotina, Basidiomycota*, *Fungi*

Reevaluation of omphalinoid and clitocyboid agarics, especially those lacking any prominent and distinct characteristic features, led to the establishment of *Contumyces* by Redhead (2002). A later homonym and illegitimate name, *Jacobia* Contu was renamed as *Contumyces* (Redhead 2002). This genus, typified by *C. rosellus* (M.M. Moser) Redhead, Moncalvo, Vilgalys & Lutzoni, comprises bright-coloured graminicolous or bryophilous agarics classified under family *Rickenellaceae* Vizzini. Previously, members of this genus were recognised under *Omphalina* Quél. owing to their omphalinoid character (Contu 1997, Redhead 2002, Larsson et al. 2006).



Fig. 143 – ***Contumyces rosellus***. Source: https://www.mykoweb.com/ CAF/ species/ Contumyces_rosellus.html. The photo has been used under the CC BY 4.0 International non-commercial license.

Members of *Contumyces* are found in sandy soils or moss beds and are documented from the Northern Hemisphere. The characteristic feature of this genus is the clustered nature of the pileo- and caulocystidia collapsing on the surface of the pileus (Redhead 2002). In the stipitipellis, caulocystidia are sometimes found to be scattered but mostly remain in clusters forming a scaly surface. *Contumyces rosellus* bears vinaceous crystalline deposits on the scales of the stipe surface. These crystalline deposits are easily dissolved in potassium hydroxide (KOH). The hyphae of the lamellar trama are irregular and bidirectional (Redhead 2002). *Contumyces* shares its closest resemblance with *Rickenella* Raithelh. and *Blasiphalia* Redhead, but is distinguished by its clustered cystidia in pileipellis, stipitipellis, and hymenium, whereas the cystidia in *Rickenella* and *Blasiphalia* are always solitary (Redhead 2002).

While reevaluating *Omphalina sensu lato*, phylogenetic analysis based on LSU sequence data of *Contumyces* has been conducted by Redhead (2002). There are three species recognised under this genus worldwide (Kalichman et al. 2020, Wijayawardene et al. 2022, Hyde et al. 2024a). The classification of *Contumyces* in GenBank, He et al. (2024) and Hyde et al. (2024a) is under *incertae sedis*, whereas Species Fungorum, MycoBank, and UNITE list it under *Rickenellaceae* and may need updating.

Synonym: *Jacobia* Contu

Type species: *Contumyces rosellus* (M.M. Moser) Redhead, Moncalvo, Vilgalys & Lutzoni

Basionym: *Clitocybe rosella* M.M. Moser

Other accepted species:

C. brunneolilacinus (Contu, Bon & Curreli) Redhead, Moncalvo, Vilgalys & Lutzoni

C. vesuvianus (V. Brig.) Redhead, Moncalvo, Vilgalys & Lutzoni

Lyoathelia Hjortstam & Ryvarden, Synopsis Fungorum (Oslo) 18, 10

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 144

Classification: *Incertae sedis, Atheliales, Agaricomycetes, Agaricomycotina, Basidiomycota*, *Fungi*

Lyoathelia is a monotypic genus established by K. Hjortstam and L. Ryvarden with its type species *L. laxa* (Burt) Hjortstam & Ryvarden, first described from coniferous wood in Canada (Hjortstam & Ryvarden 2004). *Lyoathelia laxa* is rare and has only been reported in Canada, the USA, Russia, Japan, and Spain (Burt 1925, Jülich 1972, Hjortstam & Ryvarden 2004). The classification of *Lyoathelia* in UNITE and Hyde et al. (2024a) is under *incertae sedis*, whereas Species Fungorum and GenBank list it under *Atheliaceae* and may need updating.

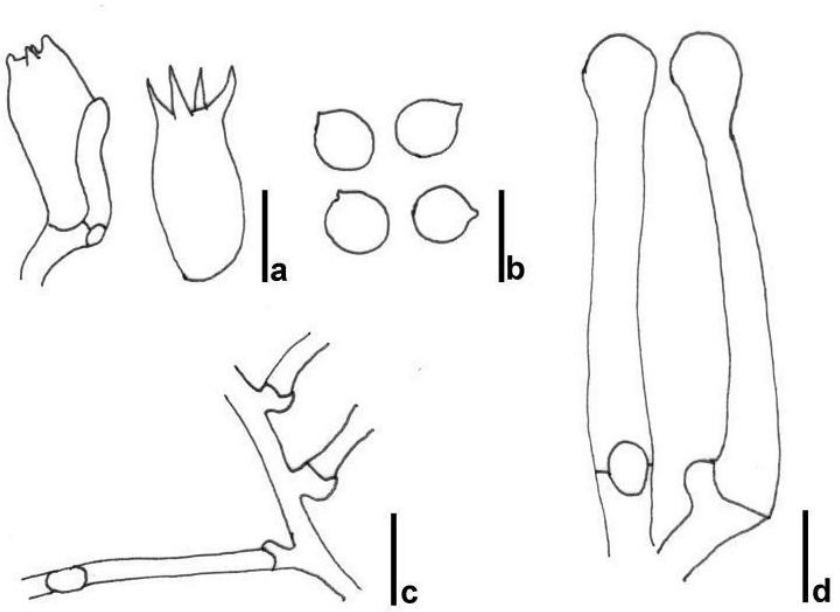


Fig. 144 – ***Lyoathelia laxa*** (holotype). a Basidia. b Basidiospores. c Hyphae. d Cystidia. Scale bar: a–d = 10 µm. Redrawn from Jülich (1972). For original basidiomata, refer to Mycoportal (2024).

The basidiomata of *Lyoathelia* is resupinate, loosely adnate, effused, thin, membranous, fragile, light cream in colour, and has a well-developed subiculum (Burt 1925, Hjortstam & Ryvarden 2004). The hymenophore is smooth, whitish, fibrillose to fimbricate, and sometimes with mycelial cords. Basidiospores are almost globose, thin to moderately thick-walled, hyaline, smooth, inamyloid, indextrinoid, acyanophilic, and have a distinct apiculus. Basidia are doliform-pedunculate in shape, mostly with four sterigmata or rarely two, and a basal clamp connection (Burt 1925, Jülich 1972, Hjortstam & Ryvarden 2004, Sulistyo et al. 2021). Cystidia are relatively rare, well-differentiated, capitate, and moderately encrusted. The hyphal system is monomitic, featuring thin-walled, narrow hyphae that are somewhat encrusted and clamped (Hjorstam & Ryvarden 2004). Sulistyo et al. (2021) used morphological and phylogenetic analyses based on combined ITS and LSU genes to further delineate *L. laxa*. It has been proposed that *L. laxa* should be classified within *Hymenochaetales* (Sulistyo et al. 2021).

Type species: *Lyoathelia laxa* (Burt) Hjortstam & Ryvarden

Basionym: *Peniophora laxa* Burt

Trechisporales K.H. Larss., Hibbett et al., Mycological Research 111(5), 541
Species Fungorum, Facesoffungi, MycoBank, GenBank

Hydnodontaceae Jülich, Bibliotheca Mycologica 85, 372
Species Fungorum, Facesoffungi, MycoBank, GenBank
Classification: *Trechisporales, Agaricomycetes, Agaricomycotina, Basidiomycota*, *Fungi*

In the contemporary taxonomic system for *Trechisporales* outlined by Hyde et al. (2024a), *Hydnodontaceae* is recognised as a well-defined lineage. This family is typified by the genus *Fibrodontia* Parmasto, which produces characteristic merulloid (wrinkled) to hydnoid (toothed) basidiomata (Larsson 2007). Molecular phylogenetic analyses have clarified the boundaries of *Hydnodontaceae*, distinguishing it from other families such as *Trechisporaceae* (containing smooth-crusted genera like *Trechispora* P. Karst.) and *Sistotremataceae* (Larsson 2007). The formal placement of *Fibrodontia* within *Hydnodontaceae* reflects a phylogenetically coherent grouping of fungi sharing distinct morphological features and evolutionary history (Larsson 2007). Currently, the family consists of ten genera: *Allotrechispora* L.W. Zhou & S.L. Liu, *Brevicellicium* K. H. Larss. & Hjortstam, *Dextrinocystis* Gilb. & M. Blackw., *Fibrodontia*, *Luellia* K.H. Larss. & Hjortstam, *Porpomyces* Jülich, *Subulicystidium* Parmasto, *Suillosporium* Pouzar, *Trechispora* P. Karst., and *Tubulicium* Oberw. (Hyde et al. 2024a).

Fibrodontia Parmasto, Conspectus Systematis Corticiacearum (Tartu), 174
Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 145
Classification: *Hydnodontaceae, Trechisporales, Agaricomycetes, Agaricomycotina, Basidiomycota*, *Fungi*

Fibrodontia was established by E. Parmasto in 1968, with *F. gossypina* as the type species (Parmasto 1968). It was distinguished from *Hyphodontia* J. Erikss. by its dimitic hyphal system with skeletal hyphae and absence of cystidia (Liu et al. 2021). Species Fungorum (2025) lists nine species worldwide. *Fibrodontia* spp. causes white rot in angiosperms, primarily in temperate and subtropical forests. *F. austrosinensis* occurs in evergreen broad-leaved forests of southwestern China, while *F. subalba* inhabits semiarid regions of northwestern China (Liu et al. 2021), the northern hemisphere, as well as Ecuador (Yurchenko & Wu 2013).

Fibrodontia is characterised by resupinate basidiomata ranging from white to yellowish, with hymenophores varying from grandinioid to hydnoid. Aculei length differs significantly among species. The hyphal system is dimitic, with clamped generative hyphae and thick-walled skeletal hyphae. Basidiospores are ellipsoid, smooth, and inamyloid (Liu et al. 2021). Molecular analyses using ITS and LSU confirmed *Fibrodontia* as monophyletic within *Trechisporales*, with interspecific genetic distances of 5.54–10.45% (Liu et al. 2021). Multi-gene phylogenies (*tef-1α* and *rpb2*) further resolved species boundaries, supporting recognition of *F. austrosinensis* and *F. subalba* as distinct lineages.

The classification of *Fibrodontia* in MycoBank, GenBank, He et al. (2024), and Hyde et al. (2024a) is under *Hydnodontaceae*, whereas Species Fungorum and UNITE list it under *Schizoporaceae* and may need updating.

Synonyms: *Cystidiodendron* Rick
Type species: *Fibrodontia gossypina* Parmasto
Other accepted species:
F. alba Yurchenko & Sheng H. Wu
F. austrosinensis S.L. Liu, S.H. He & L.W. Zhou
F. bambusicola J.H. Dong & C.L. Zhao
F. brevidens (Pat.) Hjortstam & Ryvarden
F. fimbriata (Rick) Baltazar & Rajchenb.
F. subalba S.L. Liu & L.W. Zhou
F. subaustrosinensis S.L. Liu, S.H. He & L.W. Zhou
F. tomentosa (Berk. & M.A. Curtis) Hjortstam & Ryvarden

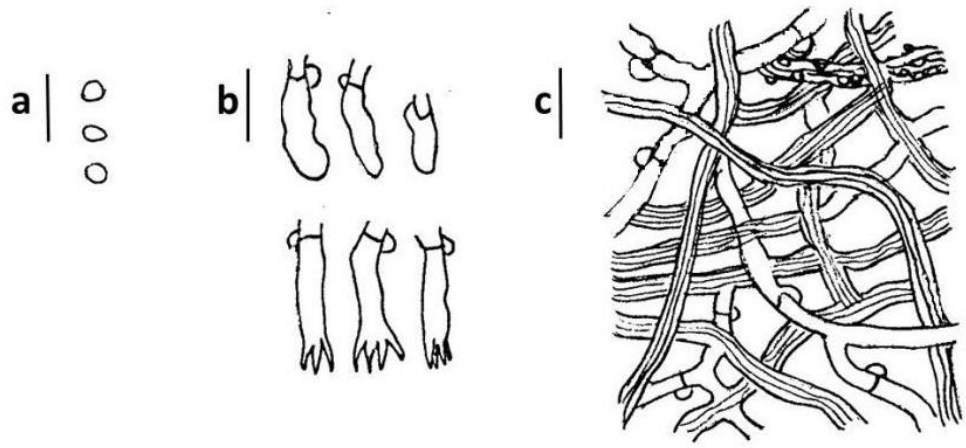


Fig. 145 – ***Fibrodontia subalba*** (holotype). a Basidiospores. b Basidia and basidioles. c Hyphae from subiculum. Scale bars: a–c = 10 µm. Redrawn from Liu et al. (2021). For original basidiomata, refer to Liu et al. (2021).

Auriculariales Bromhead, Magazine of Natural History, Journal of Zoology, Botany, Mineralogy, Geology and Meteorology, New Series 2, 333

Species Fungorum, Facesoffungi, MycoBank, GenBank

Auriculariaceae Fr., Epicrisis Systematis Mycologici, 530

Species Fungorum, Facesoffungi, MycoBank, GenBank

Classification: *Auriculariales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Auriculariaceae, the largest family in *Auriculariales* Bromhead, was established by E. Fries (1836) with *Auricularia* Bull. as the type genus (Fries 1836). Hyde et al. (2024a) reported 16 genera in this family: *Alloexidiopsis* L.W. Zhou & S.L. Liu, *Adustochaete* Alvarenga & K.H. Larss., *Amphistereum* Spirin & Malysheva, *Auricularia*, *Eichleriella* Bres., *Elmerina* Bres., *Exidia* Fr., *Exidiopsis* (Bref.) Möller, *Fibulosebacea* K. Wells & Raitv., *Heterochaete* Pat., *Heterocorticium* S.H. He, T. Nie & Yue Li, *Heteroradulum* Lloyd ex Spirin & Malysheva, *Protodaedalea* Imazeki, *Pseudostypella* McNabb, *Sclerotrema* Spirin & Malysheva, and *Tremellochaete* Raitv. *Auriculariaceae* is characterised by gelatinous, crustaceous, or woody basidiomata with transversely septate and clavate basidia (Wu et al. 2021, Li et al. 2023c, He et al. 2024). Members of this family are distributed worldwide and are saprophytic, causing wood rot (He et al. 2019). Some species are highly edible and bear medicinal properties (*Auricularia auricula-judae* (Bull.) Quél.) (He et al. 2019).

Fibulosebacea K. Wells & Raitv., Transactions of the British Mycological Society 89(3), 344

Species Fungorum, Facesoffungi, MycoBank Fig. 146

Classification: *Auriculariaceae, Auriculariales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Initially, *Fibulosebacea* was placed in *Exidiaceae* R.T. Moore (Wells & Raitvirr 1987), but is now under *Auriculariaceae* (Tadiosa & Lubos 2020). The genus is monotypic, represented by *F. strigosa* (Bourdot & Galzin) K. Wells & Raitv (Hyde et al. 2024a).

The genus is characterised by resupinate basidiomata with a thick, leathery subiculum with crust-like growth of mycelium, having scattered, waxy gelatinous fertile patches with thick margins and often covered with thick hairs. Thick-walled hyphae with clamp connections are present throughout, often arranged as radiating or net-like strands that may project to form sterile or fertile spines, and in older fruiting bodies, these seem to be completely obscured by the indeterminate hymenium. The fertile surface layer comprises ascending, mainly thin-walled hyphae terminating in the hymenium of basidia and simple to little-branched dikaryophyses. Basidia initially globose,

becoming ovoid to obovate, with (2-)4 hypobasidial segments, subtended by clamp connections, epibasidia tubular and often flexuous. The basidiospores are broadly elliptical to cylindrical, curved (Wells & Raitvirr 1987). The classification of *Fibulosebacea* in Species Fungorum, and Hyde et al. (2024a) is under *Auriculariaceae*, whereas MycoBank and UNITE list it under *Exidiaceae* and *incertae sedis*, respectively, and may need updating.

Type species: *Fibulosebacea strigosa* (Bourdot & Galzin) K. Wells & Raitv.

Basionym: *Sebacina strigosa* Bourdot & Galzin

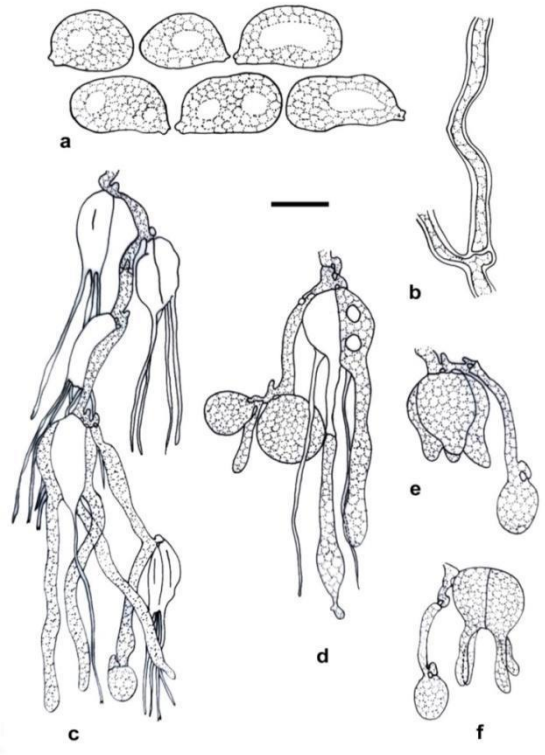


Fig. 146 – ***Fibulosebacea strigosa***. a Basidiospores. b Segment of hypha in the basal portion of trama. c–f Segments of fertile hyphae with basidia at various stages of ontogeny. Scale bars: a–f =10 µm. Redrawn from Wells & Raitvirr (1987).

Tremellochaete Raitv., Izvestiya Akademii Nauk Estonskoy SSR 13, 29

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 147

Classification: *Auriculariaceae, Auriculariales, Agaricomycetes, Agaricomycotina, Basidiomycota*, *Fungi*

Tremellochaete was established by Raitviir (1964) to accommodate *T. japonica* (Yasuda) Raitv., a species morphologically intermediate between *Exidia* Fr. and *Heterochaete* Pat. However, this genus has often been synonymised with *Exidia* (Roberts & Spooner 1998) until molecular studies confirmed its generic status (Malysheva & Spirin 2017).

The genus is characterised by resupinate basidiomata with cartilaginous to gelatinous texture. The pileus has a generally detached margin and hymenial surface with encrusted spines (Alvarenga et al. 2019). Typified by *T. japonica*, *Tremellochaete* was re-established by including *T. nigerrima* (Viégas) Spirin & Malysheva, *T. atlantica* Alvarenga, *T. cerradensis* Alvarenga, and a new combination, *T. ciliata* (Möller) Spirin & Alvarenga (Malysheva & Spirin 2017, Phookamsak et al. 2019, Tohtirjap et al. 2023). Later, *T. australiensis* F. Wu, G.M. Gates, Tohtirjap & Y.C. Dai was documented under this genus (Tohtirjap et al. 2023). Revised morphological study and molecular analysis (ITS and LSU) were undertaken on these five species of *Tremellochaete* by Tohtirjap et al. (2023). However, *Tremellochaete* is still not widely accepted as a distinct genus (Weiß & Oberwinkler 2001, Wang & Thorn 2021). The distinction between *Exidia* and *Tremellochaete* in

terms of morphology and phylogeny remains unclear (Alvarenga et al. 2019, Ye et al. 2020), which calls for a more comprehensive sampling of the taxa along with a multi-gene phylogeny (Tohtirjap et al. 2023). Hyde et al. (2024a) have recognised eight species under *Tremellochaete*, worldwide. The classification of *Tremellochaete* in *Auriculariaceae, Auriculariales, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* agrees in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Type species: *Tremellochaete japonica* (Yasuda) Raitv.

Basionym: *Exidia japonica* Yasuda

Other accepted species:

T. atlantica Alvarenga

T. australiensis F. Wu, G.M. Gates, Tohtirjap & Y.C. Dai

T. cerradensis Alvarenga

T. ciliata (Möller) Spirin & Alvarenga

T. hispidula Raitv.

T. nigerrima (Viégas) Spirin & Malysheva

T. novozealandica (Lloyd) J.A. Cooper

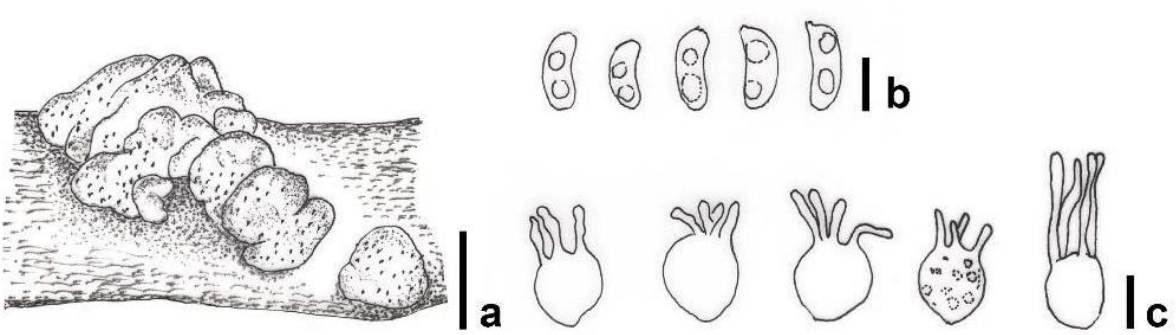


Fig. 147 – ***Tremellochaete australiensis*** (Dai 18664, holotype). a Basidiomata. b Basidiospores. c Basidia. Scale bars: a = 1 cm, b–c = 10 μm. Redrawn from Tohtirjap et al. (2023). For original basidiomata, see Tohtirjap et al. (2023).

Auriculariales genera incertae sedis

Basidiodendron Rick, Brotéria, N.S. 7, 74

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 148

Classification: *Incertae sedis, Auriculariales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Rick (1938) established *Basidiodendron* as a monotypic genus, with *B. luteogriseum* as the type species, based on a specimen collected from wood in Brazil. This classification was reaffirmed by Robena Lunk-Allen in 1963 (Luck-Allen 1963). Species of *Basidiodendron* are widespread across Eurasia, Europe, North and South America, and Africa (He et al. 2019, Spirin et al. 2020, 2021). Currently, Species Fungorum (2026) lists 41 species of *Basidiodendron*.

Basidiodendron is characterised by effused, wood-inhabiting basidiomata with a smooth or minutely warted hymenophore (Luck-Allen 1963, Spirin et al. 2021). The basidiomata are invisible when young but become visible as they mature. Fresh specimens are bluish-grey, turning pale cream or ochre with brownish spots as they dry, and quickly turning yellow when treated with KOH. The basidiospores are smooth and occasionally produce secondary basidiospores (Kotiranta & Saarenoksa 2005). The basidia are distinctive, featuring a four-celled, longitudinally septate structure located at the tips of long, sinuous hyphae. These hyphae are covered along their length

by shields of collapsed basidia and are clamped (Kotiranta & Saarenoksa 2005, Spirin et al. 2020). Gloeocystidia are prominent with longitudinal septation (Luck-Allen 1963, Kotiranta & Saarenoksa 2005, Spirin et al. 2021).

Spirin et al. (2021) used morphological characteristics and phylogenetic analyses (ITS, LSU, and *tef-1α*) to delineate species within *Basidiodendron. Basidiodendron* can be distinguished from morphologically similar genera, such as *Bourdotia* (Bres.) Bres. & Torrend, *Ductifera* Lloyd, and *Exidiopsis sensu lato* (Bref.) Möller, by its waxy or arid, non-hygroscopic basidiomata and comparatively shorter basidia, which lack a basal stalk (Luck-Allen 1963, Wells & Raitviir 1975, Spirin et al. 2021). Phylogenetic analysis supports the distinction between *Basidiodendron* and *Bourdotia* (Weiß & Oberwinkler 2001, Spirin et al. 2020). The classification of *Basidiodendron* in Species Fungorum, UNITE, and Hyde et al. (2024a) is under *incertae sedis*, whereas MycoBank and GenBank list it under *Exidiaceae* and may need updating.

Type species: *B. luteogriseum* Rick

Other accepted species: (Species Fungorum – search *Basidiodendron*)

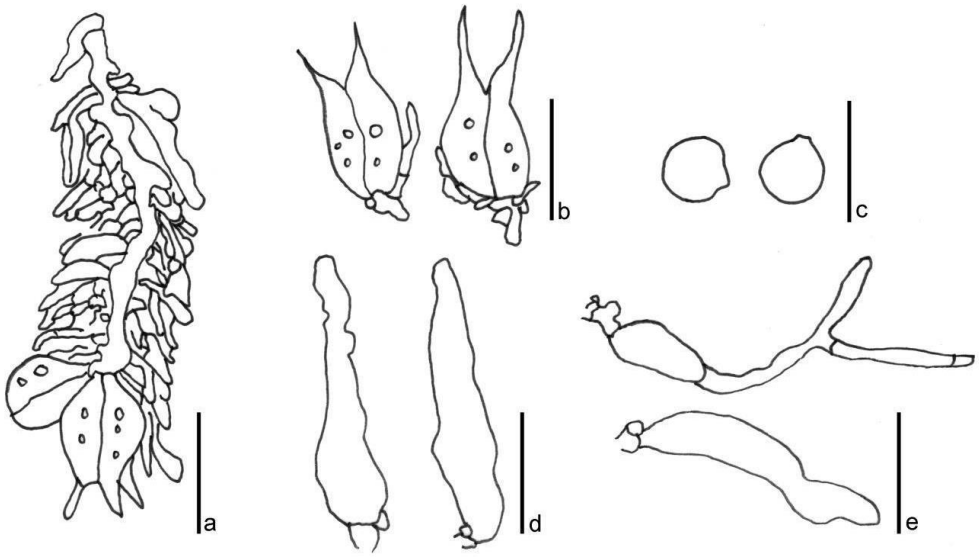


Fig. 148 – ***Basidiodendron globisporum*** (Spirin 7040). a Basidia-bearing hypha covered by collapsed basidial cells. b Basidia. c Basidiospores. d Normally developed gloeocystidia. e Gloeocystidia with hyphoid apical outgrowths. Scale bar: a−e = 10 µm. Redrawn from Spirin et al. (2020).

Ceratosebacina P. Roberts, Mycological Research 97(4), 470

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 149

Classification: *Incertae sedis, Auriculariales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Ceratosebacina was established by Peter Roberts in 1993, with *C. longispora* as the type species, based on a specimen collected from a fallen *Quercus* branch in Devon, England (Roberts 1993). The name, *Ceratosebacina,* was from a combination of *Ceratobasidium* D.P. Rogers and *Sebacina* Tul., reflecting the horned ('*cerato*') nature of the basidia (Roberts 1993). Members of *Ceratosebacina* are reported in Europe and the USA (GBIF 2024).

Ceratosebacina has resupinate, inconspicuous, effused, smooth, thin, and waxy-gelatinous basidiomata (Roberts 1993, Weiß & Oberwinkler 2001). The hyphae are clamped and proliferate from the base of the basidium, while hyphidia are absent (Roberts 1993). Basidia are 2–4 septate, globose or ovoid, with short, often lateral stalks, longitudinal septation, and clamps at the base (Roberts 1993, Weiß & Oberwinkler 2001). Sterigmata are 2−4 per basidium, appearing rigid and occasionally septate. Basidiospores are elongated, often replicating, and germinate through one or

more germ tubes (Roberts 1993). Globose microconidia, a unique character, have been observed in cultures of *C. longispora* (Ingold 1992).

Species within *Ceratosebacina* are distinguished using combined morphological and phylogenetic analysis (LSU) (Weiß & Oberwinkler 2001). Any resupinate tremellaceous fungi used to be placed in *Exidiopsis* (Bref.) Möller (Roberts 1993). Later, Roberts (1993) proved that *Ceratosebacina* differs from *Exidiopsis* (Bref.) Möller by its visible, wide, and non-gelatinised hyphae, absence of hyphidia, *Ceratobasidium*-like basidia, and sterigmata. Morphologically, *Ceratosebacina* resembles the *Ceratobasidiales* Jülich more than the *Tremellales* Fr. (Roberts 1993). Within *Ceratosebacina*, three species are recognised worldwide (He et al. 2019, Hyde et al. 2024a). The classification of *Ceratosebacina* in Species Fungorum, UNITE, and Hyde et al. (2024a) is under *incertae sedis*, whereas MycoBank and GenBank list it under *Exidiaceae* and may need updating.

Type species: *Ceratosebacina longispora* (Hauerslev) P. Roberts

Basionym: *Sebacina longispora* Hauerslev

Other accepted species:

C. calospora (Bourdot & Galzin) P. Roberts

C. prolifera (D.P. Rogers) P. Roberts

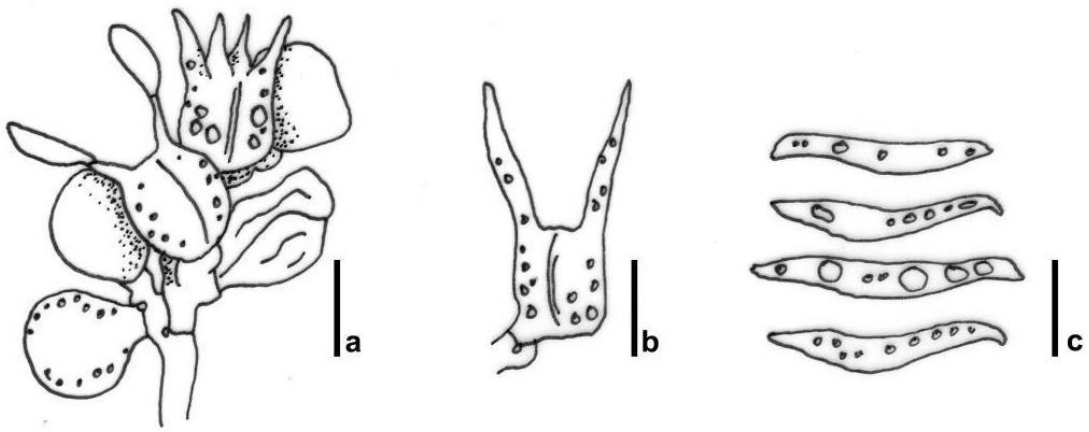


Fig. 149 – ***Ceratosebacina longispora*** (P. Roberts 319). a, b Basidia. c Basidiospores. Scale bar: a−c = 10µm. Redrawn from Roberts (1993). For original basidiomata, refer to GBIF (2024).

Endoperplexa P. Roberts, Mycological Research 97(4), 471

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 150

Classification: *Incertae sedis, Auriculariales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Endoperplexa was established by Peter Roberts in 1993, with the type species *E. dartmorica* (Roberts 1993). *Endoperplexa* species are saprobic. The name *Endoperplexa* is derived from a combination of the Greek and archaic Latin "*endo*", meaning "within", and the Latin "*perplexus*", meaning "confused", referring to the gelatinised and obscure hymenial structure (Roberts 1993).

The basidiomata of *Endoperplexa* are thin, effused, resupinate, and farinaceous to thinly ceraceous (Roberts 1993). Hyphae are thin, inconspicuous, and often nodulose in the hymenium, with or without clamp connections, forming a branching, basidia-bearing hymenium within a dense gelatinous matrix. New hyphae emerge from the base of mature basidia. Cystidia are scattered, hyaline, thin-walled, and cylindrical. Basidia are 2−4 septate, globose to wide ellipsoid, and clamped at the base, with each basidium bearing 2−4 sterigmata. Basidiospores are small, ranging from globose to ovoid to ellipsoid (Roberts 1993).

Endoperplexa is differentiated from the closely related genus *Exidiopsis* (Bref.) Möller by its inconspicuous basidiomata, narrow and nodulose hyphae, small and subglobose basidia, absence of

hyphidia, and presence of hyaline cystidia. *Endoperplexa* is distinguished from another related genus, *Basidiodendron* Rick, where basidia are successively produced on continually extending stalk cells (Roberts 1993). Both morphological and phylogenetic analyses (ITS and LSU) have been used to differentiate species within *Endoperplexa* (Weiss et al. 2004, Kühdorf et al. 2014). Currently, Species Fungorum (2026) lists six species of *Endoperplexa*. The classification of *Endoperplexa* in Species Fungorum, UNITE, and Hyde et al. (2024a) is under *incertae sedis*, whereas MycoBank and GenBank list it under *Exidiaceae* and may need updating.

Synonymy: *Opadorhiza* T.F. Andersen & R.T. Moore

Type species: *Endoperplexa dartmorica* P. Roberts

Other accepted species:

E. enodulosa (Hauerslev) P. Roberts
E. obscura (G.W. Martin) P. Roberts
E. phlebioides P. Roberts
E. subfarinacea (Hauerslev) P. Roberts
E. tortola P. Roberts

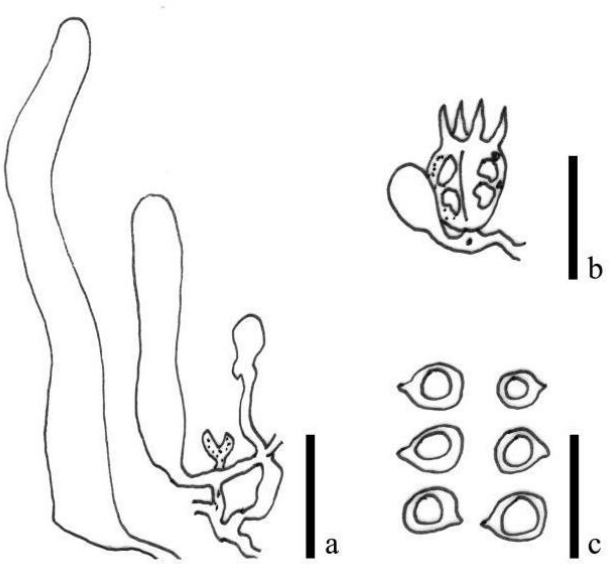


Fig. 150 – ***Endoperplexa dartmorica*** (P. Roberts 382, holotype). a Cystidia. b Basidia, showing proliferation from the sub-basidial clamp connection. c Basidiospores. Scale bar: a–c = 10 µm. Redrawn from Roberts (1993). For original basidiomata, refer to GBIF (2024).

Hauerslevia P. Roberts, Cryptogamie, Mycologie 19(4), 277

Species Fungorum, Facesoffungi, MycoBank Fig. 151

Classification: *Incertae sedis, Auriculariales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Hauerslevia is a monotypic genus established by P. Roberts in 1998, with its type species, *H. pulverulenta* (Roberts 1998, Hyde et al. 2024a). The name honours Danish mycologist K. Hauerslev (Roberts 1998). The type species was originally described as *Sebacina pulverulenta* Hauerslev, within *Tremellaceae* Fr., based on specimens collected on the bark of a broadleaf tree in Stigsnaes, Denmark (Hauerslev 1976, Roberts 1998). This genus is considered rare in parts of Europe, including Denmark, the UK, France, and the European part of Russia (Roberts 1998, Garnier-Delcourt et al. 2010, Bolshakov et al. 2022). The genus has been included in the list of protected generic names for fungi (Kirk et al. 2013).

Hauerslevia is characterised by thin, effused, greyish, and somewhat ceraceous resupinate basidiomata, with a thin, open-textured hymenium composed of a single layer of basidia intermixed with cystidia (Roberts 1998). The basidiospores are elongated and capable of producing secondary

spores by replication. Basidia are subglobose to ellipsoid, bear a lateral stalk, and are 4-spored, while the sterigmata are widest at the base, closely set, and become contiguous towards the base. Cystidia are tubular, thin-walled, hypha-like structures, often sinuous, with prominently cyanophilic granules at their apex. Hyphae are hyaline, thin-walled, and lack clamp connections (Roberts 1998).

Due to a lack of molecular sequences, delineation from closely related genera is solely based on morphological characteristics (He et al. 2019). *Hauerslevia* resembles *Ceratobasidium* D.P. Rogers and *Ceratosebacina* P. Roberts in hymenial structure, hyphae, and basidia (Roberts 1998). However, it can be distinguished from these genera as *Ceratobasidium* possesses aseptate basidia, and *Ceratosebacina* has septate basidia. The classification of *Hauerslevia* in *Incertae sedis, Auriculariales, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* agrees in Species Fungorum, MycoBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Type species: *Hauerslevia pulverulenta* (Hauerslev) P. Roberts

Basionym: *Sebacina pulverulenta* Hauerslev

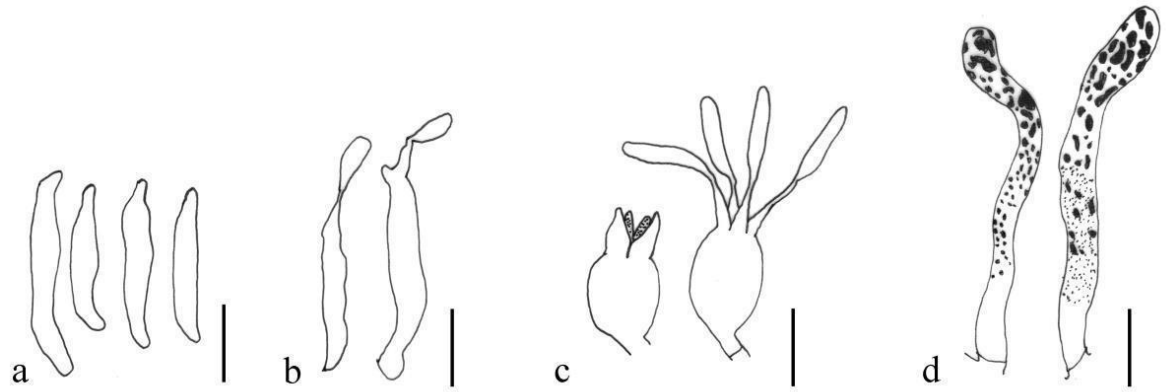


Fig. 151 – ***Hauerslevia pulverulenta***. a Basidiospores. b Basidiospores, self-replicating. c Basidia. d Cystidia. Scale bar: a–d = 10 µm. Redrawn from Roberts (1998). For original basidiomata, refer to GBIF (2025).

Heterorepetobasidium Chee J. Chen & Oberw., Mycologia 94(3), 515

Species Fungorum, Facesoffungi, MycoBank Fig. 152

Classification: *Incertae sedis, Auriculariales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Heterorepetobasidium was established by D.J. Chen, F. Oberwinkler & Z.C. Chen in 2002, with its type species *H. subglobosum* (Chen et al. 2002). This species was described from specimens collected on decaying wood in Taiwan, China. At the same time, Chen et al. (2002) described another new species, *H. ellipsoideum* Oberw. & Chee J. Chen, from Taiwan, China.

Heterorepetobasidium is characterised by thin, effused, whitish, creamy, or translucent basidiomata that are waxy when fresh and horny when dry (Chen et al. 2002). The basal hyphae are thin, mostly tortuous, and clamped. Hyphidia are branched protrusions into the hymenium and are present rarely. Basidiospores are hyaline, thin-walled, smooth, and inamyloid, and they germinate through secondary spores. Basidia are subglobose to clavate or pyriform with longitudinal partial septation and develop terminally from small, clamped generative hyphae. The sterigmata are swollen at the base while abruptly tapering into spiculae. New basidia grow through the mature ones in a repetobasidial development pattern, leaving old basidia as sheaths around them. Gloeocystidia arise terminally or laterally from the basal or sub-hymenium, while pleurogleocystidia bear lateral hyphal appendages. Dolipores are with continuous parenthesomes, each perforated only centrally by one micropore (Chen et al. 2002).

Species delineation of *Heterorepetobasidium* from other closely related genera is solely based on morphological characteristics due to the lack of molecular sequences (He et al. 2019). Morphologically, this genus is similar to *Repetobasidium* J. Erikss. and *Repetobasidiellum* J. Erikss. & Hjortstam (Eriksson et al. 1981, Oberwinkler & Tschen 1990). However, the latter genera are distinct by the lack of partially septate basidia, secondary spores, and gloeocystidia (Chen et al. 2002). The classification of *Heterorepetobasidium* in *Incertae sedis, Auriculariales, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* agrees in Species Fungorum, MycoBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Type species: *Heterorepetobasidium subglobosum* Chee J. Chen & Oberw.

Other accepted species: *H. ellipsoideum* Oberw. & Chee J. Chen

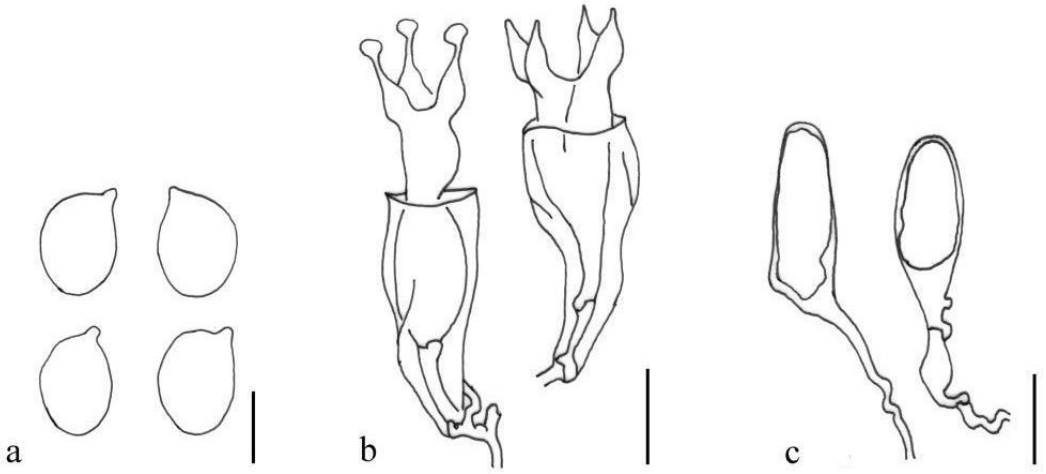


Fig. 152 – ***Heterorepetobasidium subglobosum***. a Basidiospores. b Basidia. c Gloeocystidia. Scale bar: a = 5 µm, b–c = 10 µm. Redrawn from Chen et al. (2002).

Protohydnum Möller, Botanische Mitteilungen aus den Tropen 8, 131, 173

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 153

Classification: *Incertae sedis*, *Auriculariales*, *Agaricomycetes*, *Agaricomycotina*, *Basidiomycota*, *Fungi*

Protohydnum was originally described by A. Möller in 1895, with *P. cartilagineum* Möller designated as the type species (Malysheva et al. 2018). It was established to accommodate gelatinous, corticioid fungi with hydnoid hymenophores. The genus was originally described from Brazil and remains monotypic, with *P. cartilagineum* as the only confirmed species. Historical misapplications of the genus, such as *P. piceicola* Kühner and *P. sclerodontium* (Mont. & Berk.) Hjortstam & Spooner have since been corrected through molecular phylogenetic studies and are now placed in *Hyalodon* Malysheva & Spirin and *Elmerina* Bres., respectively (Malysheva et al. 2018).

Species in *Protohydnum* are resupinate, hydnoid fungi that cause white rot on dead wood. *Protohydnum cartilagineum* occurs especially in humid, tropical forest environments. The genus is currently known only from South and Central America, particularly Brazil, though its presence in other tropical regions remains plausible pending further exploration (Malysheva et al. 2018).

Basidiomata of *Protohydnum* are resupinate, gelatinous to cartilaginous in texture, and firmly adnate to the substrate. The hymenial surface is hydnoid, covered with short, dense spines (aculei), and is yellow to ochraceous in colour. With age, the texture becomes tougher, and the surface may appear slightly rugose (Malysheva et al. 2018). The hyphal system is monomitic, with gelatinised generative hyphae bearing clamp connections. Basidia are transversely septate (auricularioid), and basidiospores are ellipsoid, smooth, hyaline, and thin-walled. Cystidia may be present, but are not a consistent feature across all samples. Spore deposits are white (Malysheva et al. 2018).

The classification of *Protohydnum* in Species Fungorum, UNITE, and Hyde et al. (2024a) is under *Auriculariales* genus *incertae sedis*, whereas MycoBank and GenBank list it under *Exidiaceae* and may need updating.

Recent phylogenetic analyses using ITS and LSU sequences have clarified the taxonomic placement of *Protohydnum*. The genus is confirmed as a member of the *Auriculariaceae* within the *Auriculariales* (Malysheva et al. 2018). Earlier associations of *Protohydnum* with taxa in *Hydnodontaceae* or *Trechisporales* were due to misidentified species that have since been reclassified. *Protohydnum* forms a distinct clade, separated from other gelatinous, corticioid genera such as *Hyalodon* and *Elmerina* (Malysheva et al. 2018).

Type species: *Protohydnum cartilagineum* Möller

Basionym: *Tremellodon cartilagineus* (Möller) Rick

Other accepted species: (Species Fungorum – search *Protohydnum*)

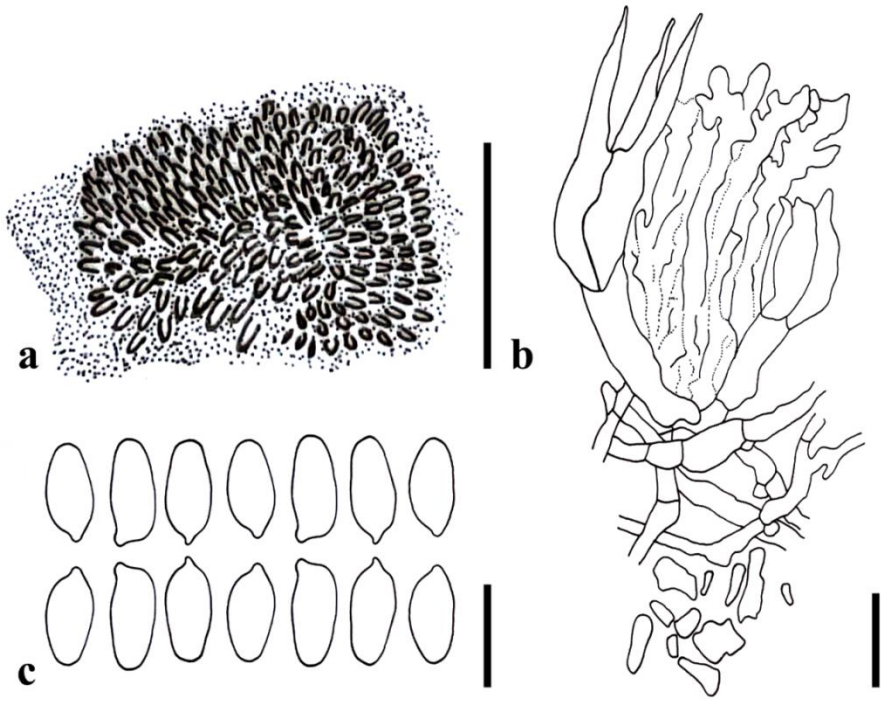


Fig. 153 – ***Protohydnum cartilagineum***. a Basidiomata. b Hymenium. c Basidiospores.Scale bar: a = 10 mm, b−c = 10 μm. Redrawn from Malysheva et al. (2018). For original basidiomata, refer to Malysheva et al. (2018).

Pseudohydnum P. Karst., Notiser ur Sällskapets pro Fauna et Flora Fennica Förhandlingar 9, 374

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 154

Classification: *Incertae sedis, Auriculariales, Agaricomycetes, Agaricomycotina*, *Basidiomycota*, *Fungi*

Pseudohydnum is characterised by its gelatinous, flabellate basidiomata, hymenium with conical spines, monomitic hyphae, and globose or ellipsoid basidiospores (Karsten 1868, Niveiro & Popoff 2011, Zhou et al. 2022). The genus can be easily identified by its longitudinally cruciate-septate (tremelloid) basidia. This character is unlike the other members in the same order, which have transversely septate (auricularioid) basidia (Karsten 1868, Breitenbach & Kränzlin 1986, Courtecuisse & Lowy 1990, Niveiro & Popoff 2011, Zhou et al. 2023a). The presence of the tremelliod basidia was why *Pseudohydnum* was placed earlier under *Tremellales* Fr. (Breitenbach & Kränzlin 1986, Niveiro & Popoff 2011). On the other hand, based on the similarity of basidiospore germination, *Pseudohydnum* and *Exidia* Fr. (*Auriculariales*) were assumed to be close (Ingold 1982, 1985). Later, Bandoni (1984) revised *Auriculariales* depending on the microscopic, ecological, and developmental characteristics and placed *Pseudohydnum* under the family

Aporpiaceae Bondartsev & Bondartseva, along with other taxa having myxarioid basidia. The affinity of *Pseudohydnum* towards *Auriculariales* was confirmed by molecular studies by Weiß & Oberwinkler (2001); however, its systematic position under any family is still ambiguous. Thus, the genus is currently classified as *Incertae sedis* under *Auriculariales*. To date, phylogenetic analysis with ITS, LSU, *tef-1α*, and *rpb1* markers has been done for this genus (Spirin et al. 2023). The classification of *Pseudohydnum* in Species Fungorum, GenBank, UNITE, and Hyde et al. (2024a) is under *incertae sedis*, whereas MycoBank lists it under *Exidiaceae* and may need updating.

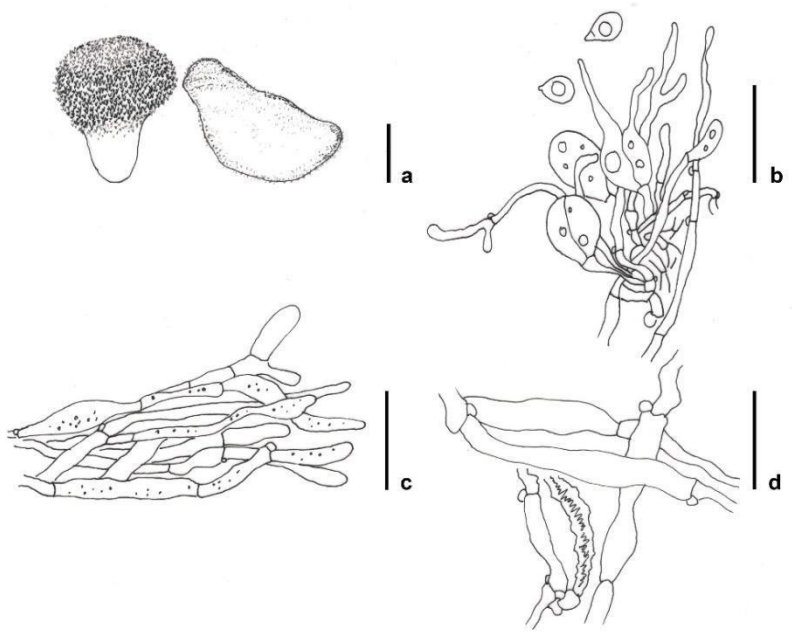


Fig. 154 – ***Pseudohydnum gelatinosum*** (epitype). a Basidiomata. b Basidia, hyphidia, subhymenial hyphae. c Hyphae of the pileal surface. d Tramal hyphae. Scale bars: a = 1 cm, b–d = 10 μm. Redrawn from Spirin et al. (2023).

The type species, *Pseudohydnum gelatinosum* (Scop.) P. Karst., often known as the "toothed jelly" mushroom, was first described as *Hydnum gelatinosum* Scop. from Europe (Scopoli 1772). It has also been documented in North America in the form of two varieties, *P. gelatinosum* var. *bisporum* Lowy & Courtec. and *P. gelatinosum* var. *paucidentatum* Lowy (Lowy 1959, 1971, Courtecuisse & Lowy 1990), eventually synonymised as *P. gelatinosum* (Spirin et al. 2023). It is identified by its pale-coloured, stipitate basidiomata with a stipe and spinoid hymenium (Spirin et al. 2023). The name has been applied worldwide, spanning Europe, North America, South America, New Zealand, Asia, and Australia, for all the similar-looking species (Wojewoda 1981). This species is well known for its medicinal and culinary uses as well as antitumor, antioxidant, and antimicrobial properties (Boulet 2003, Binion et al. 2008, Wu et al. 2019a, Sternisa et al. 2022). Within *Pseudohydnum,* Species Fungorum (2026) recognised 29 species worldwide.

Synonym: *Hydnogloea* Curr., Berk. & Broome, *Hydnum* sect. *Tremellodon* Pers., *Tremellodon* (Pers.) Fr.

Type species: *Pseudohydnum gelatinosum* (Scop.) P. Karst.

Basionym: *Hydnum gelatinosum* Scop.

Other accepted species: (Species Fungorum – search *Pseudohydnum*)

Gomphales Jülich, Bibliotheca Mycologica 85, 348

Species Fungorum, Facesoffungi, MycoBank, GenBank

Gomphaceae Donk, Persoonia 1(4), 406

Species Fungorum, Facesoffungi, MycoBank, GenBank

Classification: *Gomphales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Gomphaceae was established by M.A. Donk (1961) with *Gomphus* Pers. as the type genus (Donk 1961). The family consists of 15 genera: *Araeocoryne* Corner, *Ceratellopsis* Konrad & Maubl., *Delentaria* Corner, *Destuntzia* Fogel & Trappe, *Gautieria* Vittad., *Gloeocantharellus* Singer, *Gomphus*, *Luteudorsum* Z.J. Peng, X.Y. Liu, & Z.D. Yu, *Phaeoclavulina* Brinkmann, *Protogautieria* A.H. Sm., *Pseudogomphus* R. Heim, *Ramaria* Fr. ex Bonord., *Ramaricium* J. Erikss., *Terenodon* Maas Geest., and *Turbinellus* Earle (Hyde et al. 2024a). Members of the family are distributed worldwide and are either saprophytic (wood-decaying) or ectomycorrhizal (He et al. 2019). Some species in this family are edible and medicinal, including *Gomphus clavatus* (Pers.) Gray, *Ramaria flava* (Schaeff.) Quél., and *Turbinellus floccosus* (Dai et al. 2010, Gursoy et al. 2010, Makropoulou et al. 2012, Lamus et al. 2015, He et al. 2019).

Gautieria Vittad., Monographia Tuberacearum (Milano), 25

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 155

Classification: *Gomphaceae, Gomphales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Gautieria was established by Vittadini in 1831 to honour the Italian physician and naturalist Giuseppe Gautier (Vittadini 1831). Vittadini described two species collected from beneath oak trees in Lombardy, Italy, naming them *G. morchelliformis* and *G. graveolens*. Additional species have since been identified across the Northern Hemisphere, South America, and Oceania (Bougher & Lebel 2001, Yang et al. 2023, Vidal et al. 2023). Currently, Species Fungorum (2026) lists 48 species of *Gautieria*.

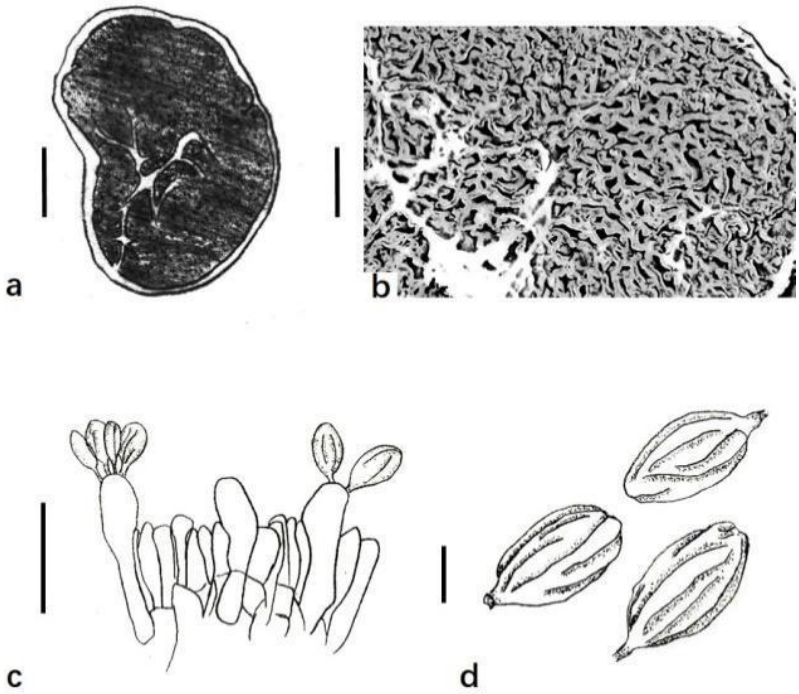


Fig. 155 – ***Gautieria***. a. Basidiomata Section. b. Gleba Section. c. Hymenophore and basidia. d. Basidiospores. Scale bars: a = 5 mm, b = 1 mm, c = 20 µm, d = 10 µm. Redrawn from Vidal et al. (2023).

Gautieria is characterised by its hypogeous basidiomata, which lack a true peridium and often expose a morchelloid surface, revealing external locules (Vidal et al. 2023). The hymenophore develops in a coralloid pattern, featuring large, hollow locules arranged more or less radially around a tree-like columella. This columella originates from a basal rhizomorph embedded in a

white mycelial mass (Vidal et al. 2023). Notably, the surfaces of both basidiomata and hymenophore turn green upon contact with $FeSO_4$ (Vittadini 1831, Vidal et al. 2023). As a result, *Gautieria* bears a notable resemblance to the coralloid genus *Ramaria* Fr. ex Bonourd (Vidal et al. 2023). Members of *Gautieria* are typically ectomycorrhizal, forming symbiotic relationships with tree partners such as *Pinaceae*, *Betulaceae*, and *Fagaceae* (López de Heredia et al. 2007, Linares 2011, Simeone et al. 2013, Tsuda et al. 2016, Vidal et al. 2023). The classification of *Gautieria* in *Gomphaceae, Gomphales, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* agrees in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Synonymy: *Ciliciocarpus* Corda, *Hydnospongos* Wallr., *Uslaria* Nieuwl.

Type species: *Gautieria morchelliformis* Vittad.

Other accepted species: (Species Fungorum – search *Gautieria*)

Gomphus Pers., Tentamen Dispositionis Methodicae Fungorum (Lipsiae), 74

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 156

Classification: *Gomphaceae, Gomphales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Gomphus is a widespread terrestrial gomphoid genus (Segedin 1984, Giachini 2004, Liu et al. 2022a). This genus was established by Persoon in 1797 (Liu et al. 2022a). *Gomphus sensu lato* is a polyphyletic group with multiple genera: *Gloeocantharellus* Singer, *Gomphus sensu stricto*, *Phaeoclavulina* Brinkmann, and *Turbinellus* Earle (Giachini & Castellano 2011, Liu et al. 2022a, Fan et al. 2023). Fan et al. (2023) reported that *Gomphus sensu lato* and *Ramaria sensu lato* are paraphyletic within *Gomphaceae*. The pileus is fan-shaped to slightly funnel-shaped and bright violet, pale olivaceous or brown; hymenium is 'merulioid' wrinkled to almost poroid, and violet venaceous brown to milky coffee colour; basidiospores have verrucose non-anastomosed ornamentation, present clamped hyphae (Giachini & Castellano 2011, Giachini et al 2012).

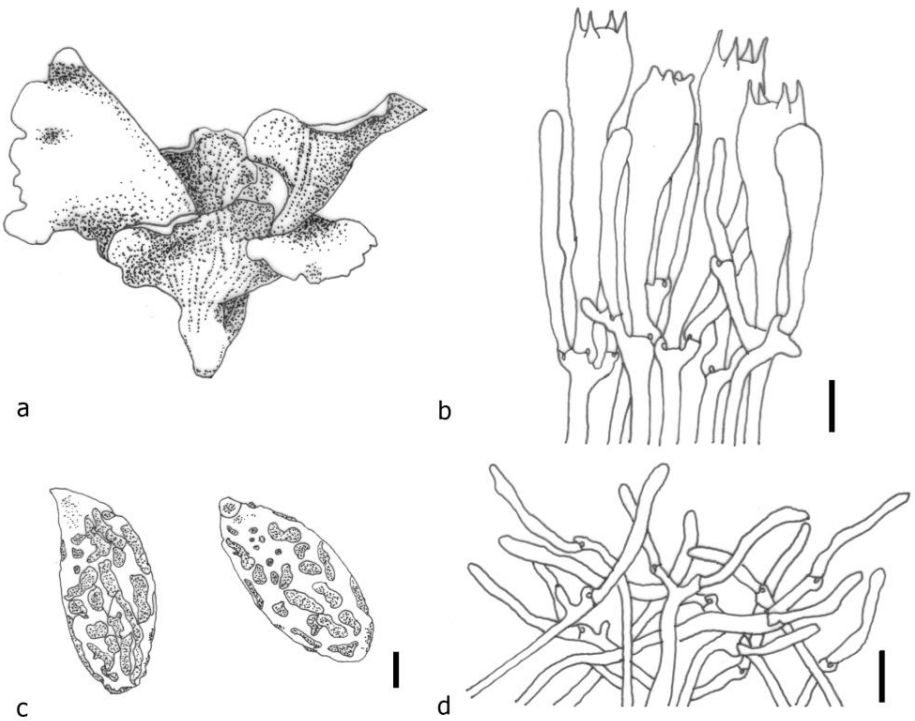


Fig. 156 – ***Gomphus orientalis***. a Basidiomata. b Hymenium and sub-hymenium. c Basidiospores. d Longitudinal section of pileipellis. Scale bar: b–d = 10 μm, c = 2 μm. Redrawn from Fan et al. (2023). For original basidiomata, refer to Fan et al. (2023).

Previously, new species were described based on morphology only (Barbara 1984). Liu et al. (2022a) used both morphological and phylogenetic studies (ITS and LSU) to identify a new species, *Gomphus matijun.* Fan et al. (2023) used the combinations of three molecular markers, ITS, LSU, and *tef1-α,* for phylogenetic analysis of *Gomphus* specimens and established a new species, *Gomphus violoaceus*. The classification of *Gomphus* in *Gomphaceae, Gomphales, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* agrees in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a). Currently, Species Fungorum (2026) lists 16 species of *Gomphus*.

Gomphus clavatus is considered a medicinal mushroom due to its antioxidant and chemopreventive properties and is a widely consumed and tasty edible mushroom (Pilz et al. 2003, Makropoulou et al. 2012).

Synonymy: *Gomphora* Fr., *Neurophyllum* Pat.

Type species: *Gomphus clavatus* (Pers.) Gray

Basionym: *Merulius clavatus* Pers.

Other accepted species: (Species Fungorum – search *Gomphus*)

Turbinellus Earle, Bulletin of the New York Botanical Garden 5, 407

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 157

Classification: *Gomphaceae, Gomphales, Agaricomycetes, Agaricomycotina, Basidiomycota*, *Fungi*

Turbinellus was established by F.S. Earle in 1909, with *T. floccosus* as the type species (Earle 1909). The latter was originally described as *Cantharellus floccosus* from specimens associated with *Fagus* in Pennsylvania, USA (von Schweinitz 1832). The genus has undergone several revisions. It was once transferred to *Gomphus* Pers., then to *Cantharellus* Adans. ex Fr., and later back to *Gomphus,* and exhibits challenges in species delineation due to limited morphological differentiation (Giachini & Castellano 2011). Within *Turbinellus*, Species Fungorum (2026) lists only 16 species worldwide. Some species, including *T. floccosus*, form ectomycorrhizal associations with *Abies*, *Pinus*, *Pseudotsuga*, *Tsuga*, and *Quercus* (González-Ávila et al. 2013, Lamus et al. 2015). Members of *Turbinellus* are distributed worldwide, except Antarctica and Australia (Giachini et al. 2012, Lamus et al. 2015).

Members of *Turbinellus* are characterised by persistent, stalked, funnel-shaped, cantharelloid-like basidiomata (Lamus et al. 2015). The pileus is orange-yellow to orange scarlet, blood red, pale orange, orange, or brown, often changing on drying, and the scale colour is darker than the pileus (Giachini & Castellano 2011). The hymenium is strongly decurrent, and hymenial folds are deeply wrinkled with longitudinal orientation. The stipe is tall, robust, fleshy, and well-rooted in the substrate. Basidiospores are verrucose, ellipsoid to obovoid. The hyphae are clampless (Giachini et al. 2012).

The classification of *Turbinellus* in *Gomphaceae, Gomphales, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* agrees in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a). Recently, Fan et al. (2023) described nine new species of *Turbinellus* using multi-gene phylogenetic analysis (ITS, LSU, and *tef1-α*), along with morphological characteristics. Some species, such as *T. floccosus*, are valued as edible (Lamus et al. 2015). In controlled cultivation, Lamus et al. (2015) have successfully inoculated a pure culture of *T. floccosus* with *Abies religiosa* and confirmed ectomycorrhizal associations.

Type species: *Turbinellus floccosus* (Schwein.) Earle ex Giachini & Castellano

Basionym: *Cantharellus floccosus* Schwein.

Other accepted species: (Species Fungorum – search *Turbinellus*)

Hysterangiales K. Hosaka & Castellano, Hosaka et al., Mycologia 98(6), 956

Species Fungorum, Facesoffungi, MycoBank, GenBank

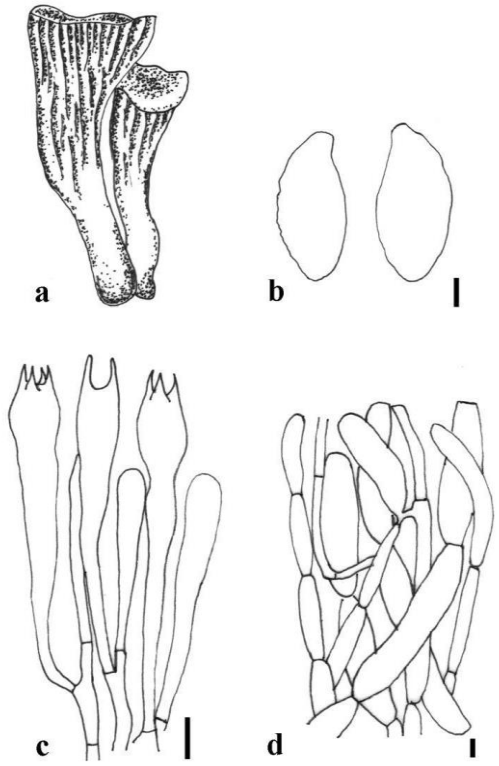


Fig. 157 – ***Turbinellus flavidus*** (HKAS 99946, holotype). a Basidiomata. b Basidiospores. c Basidia and basidioles. d Pileipellis Scale bar: b = 2 µm, c–d = 10 µm. Redrawn from Fan et al. (2023). For original basidiomata, refer to Fan et al. (2023).

Hysterangiaceae E. Fisch., in Engler & Prantl, Die natürlichen Pflanzenfamilien, Teil I, Abteilung 1**, 304

Species Fungorum, Facesoffungi, MycoBank, GenBank

Classification: *Hysterangiales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Hysterangiaceae was established by E. Fischer in 1899 to accommodate gasteroid taxa and typified by *Hysterangium* Vittad. The family consists of three genera: *Aroramyces* Castellano & Verbeken, *Hysterangium*, and *Statesia* Castellano, T. Lebel, Davoodian & K. Hosaka (He et al. 2024). This family was also classified in *Phallales* E. Fisch. by some authors (Dring 1973, Miller & Miller 1988), while most accepted it in order *Hysterangiales* K. Hosaka & Castellano (Jülich 1981, Hyde et al. 2024a). Members of the family are distributed worldwide and form ectomycorrhizal associations with vascular plants, including *Eucalyptus*, *Kunzea*, and *Leptospermum* (He et al. 2019, Davoodian et al. 2021).

Hysterangium Vittad., Monographia Tuberacearum (Milano), 13

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 158

Classification: *Hysterangiaceae, Hysterangiales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Vittadini (1831) established *Hysterangium*, initially including three species: *H. clathroides*, *H. membranaceum*, and *H. fragile*. As more species have been described globally, *Hysterangium* has expanded to become one of the larger genera of hypogeous fungi, now comprising 65 recognised species (Hyde et al. 2024a). The genus has a widespread distribution, primarily in the Northern Hemisphere, although some species have been reported from South America, Oceania, and Africa (Zeller & Dodge 1929, Castellano 1988, Castellano 1999, Sulzbacher et al. 2019, Elliott et al. 2020).

Hysterangium is characterised by the formation of hypogeous basidiomata (Castellano 1988, Liu et al. 2005). The peridium is typically white to salmon pink, pale yellow, or pale brown, and in

many species, stains pink to brown when bruised. The peridium is often easily separable from the gleba, and can produce numerous hyphae and rhizomorphs on its base and sides or even cover the entire surface. The gleba varies in colour from pink to grey, greyish-green, olive, or pale brown, with a labyrinthine chambered structure with branched, gelatinous, or cartilaginous columellae. The odour may be faint or fruity. Basidiospores are hyaline, narrowly ellipsoid or broadly fusiform, and can be pale green, pale olive, or pale brownish yellow, with surfaces that may be smooth, warty, or covered with sinuate transverse ridges (Castellano 1988, Liu et al. 2005).

Species delineation within *Hysterangium* is done using both morphological traits and phylogenetic analyses (LSU, SSU, *atp6*, and *tef-1α*) (Sulzbacher et al. 2019). In the Northern Hemisphere, they are often symbiotic with *Pinaceae* and *Fagaceae*, with Douglas fir being a common host in North America (Castellano 1988, Liu et al. 2005). In Australia (Malajczuk et al. 1987), species of *Hysterangium* are frequently associated with *Eucalyptus* spp. The classification of *Hysterangium* in *Hysterangiaceae, Hysterangiales, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* agrees in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Synonymy: *Mylitta* Fr.

Type species: *Hysterangium clathroides* Vittad.

Other accepted species: (Species Fungorum – search *Gautieria*)

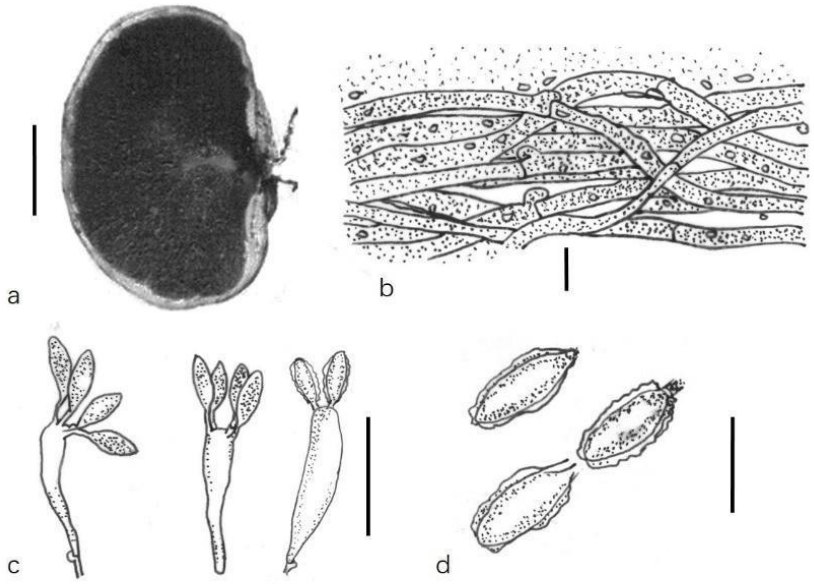


Fig. 158 – ***Hysterangium rupticutis***. a. Basidiomata section and gleba. b Interwoven hypha in peridium. c Basidia and basidiospore. d. Basidiospore. Scale bars: a = 1 cm, b = 5 µm, c = 20 µm, d. = 10 µm. Redrawn from: Castellano (1988) and Castellano (1999).

Mesophelliaceae Jülich, Bibliotheca Mycologica 85, 379

Species Fungorum, Facesoffungi, MycoBank, GenBank

Classification: *Hysterangiales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Mesophelliaceae was established by W. Jülich (1982) and typified by *Mesophellia* Berk. (Jülich 1982). The family consists of eight genera: *Andebbia* Trappe, Castellano & Amar., *Castoreum* Cooke & Massee, *Chondrogaster* Maire, *Gummiglobus* Trappe, Castellano & Amar., *Gummivena* Trappe & Bougher, *Malajczukia* Trappe & Castellano, *Mesophellia*, and *Nothocastoreum* G.W. Beaton (He et al. 2024). Members of the family are endemic to Australasia, mainly in Australia (He et al. 2024). Species in *Mesophelliaceae* produce long-lived basidiomata that are found throughout the year, even in burnt forests, providing food for wild animals (Claridge et al. 1993, 2004). The basidiomata tissue is composed of narrow cells with strongly gelatinised

walls and leathery to brittle outer peridium (Dell et al. 1990, Trappe et al. 1992, Claridge et al. 2004).

Chondrogaster Maire, Bulletin Trimestriel de la Société Mycologique de France 40(4), 312
Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 159
Classification: *Mesophelliaceae, Hysterangiales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Chondrogaster is a genus of truffle-like fungi in *Mesophelliaceae*. The genus was described by French mycologist René Maire in 1926 (Maire 1926). *Chondrogaster* contains two species, the type *C. pachysporus*, and *C. angustisporus* (Giachini et al. 2000, Hyde et al. 2024a). The genus is readily distinguished by enclosed hypogeous basidiomata, which bear a loculate gleba composed of tramal plates where basidia and basidiospores are produced (Castellano et al. 1989, Sulzbacher et al. 2010). *Chondrogaster* are found in the Mediterranean region, North America, Australia, Uruguay, and southern Brazil (Maire 1926, Lago & Castro 2004, Giachini et al. 2000, Sulzbacher et al. 2010). The two known species are both associated with *Eucalyptus*, being collected from the understory of *Eucalyptus* tree species (Lago & Castro 2004).

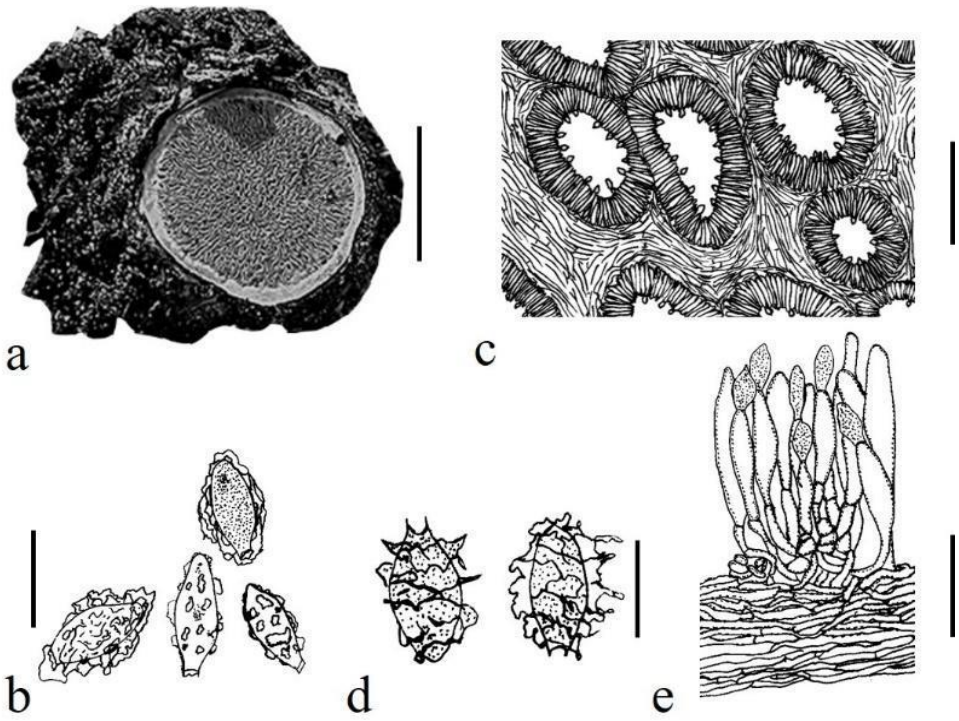


Fig. 159 – ***Chondrogaster angustisporus*** (a–b). a Gleba and surface attachments on basidiospores. b Mature basidiospores. ***Chondrogaster pachysporus*** (c–e). c Gleba structure. d Mature basidiospores. e Detail of the hymenium and trama. Scale bars: a = 5 mm, b = 10 µm, c = 100 µm, d = 10 µm, e = 20 µm. Redrawn from Sulzbacher et al. (2010), Giachini et al. (2000). For original basidiomata, refer to Sulzbacher et al. (2010) and Giachini et al. (2000).

Chondrogaster pachysporus, the type species of the genus, has basidiospores with irregularly reticulate surfaces at maturity and of variable diameter (Lago & Castro 2004). Basidia are monosporic. *Chondrogaster angustisporus* has narrower basidiospores with less coarse ornamentation, and basidia are bisporic. This genus is closely related to *Hysterangium* Vittad., which differs in lacking a distinct columella and the presence of a mycelial mass covering the whole basidiomata (Giachini et al. 2000). The classification of *Chondrogaster* in Species Fungorum, MycoBank, UNITE, and Hyde et al. (2024a) is under *Mesophelliaceae*, whereas GenBank lists it under *incertae sedis* and may need updating.

Type species: *Chondrogaster pachysporus* Maire
Other accepted species:
Chondrogaster angustisporus Giachini, Castellano, Trappe & V.L. Oliveira

Phallales E. Fisch., Engler & Prantl, Die natürlichen Pflanzenfamilien, Teil I, Abteilung 1, 276
Species Fungorum, Facesoffungi, MycoBank, GenBank

Clathraceae Chevall., Flore Générale des Environs de Paris 1, 120
Species Fungorum, Facesoffungi, MycoBank, GenBank
Classification: *Phallales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Clathraceae, belonging to *Phallales* E. Fisch., is commonly known as the lattice stinkhorns or cage stinkhorns. Though the classification of these fungi remained highly dynamic, the one by Dring (1980) has been adapted by most of the subsequent researchers (Coetzee 2010). It recognised 16 species of *Clathrus* P. Micheli ex L. (type genus) worldwide and grouped the family into nine core genera: *Clathrus*, *Laternea* Turpin, *Blumenavia* Möller, *Ileodictyon* Tul., *Colus* Cavalier & Séchier, *Pseudocolus* Lloyd, *Anthurus* Kalchbr. & MacOwan, *Lysurus* Fr., and *Aseroë* Labill (Putra et al. 2025). Dring (1980) emphasised the dispersion of the gleba over the inner surface of the receptacle as a primary diagnostic feature for the type genus *Clathrus*. Kirk et al. (2001) merged *Clathraceae* into *Phallaceae* Corda. With the molecular phylogenetics of gomphoid/phalloid fungi, Hosaka et al. (2006) resolved *Clathraceae* to be a monophyletic group. Currently, the family with a total of 10 genera: *Abrachium* Baseia & T.S. Cabral, *Aseroë*, *Blumenavia*, *Clathrus*, *Colus*, *Ileodictyon*, *Hosakaea* Mujic & M.E. Sm., *Laternea*, *Ligiella* J.A. Sáenz, and *Pseudocolus* (Hyde et al. 2024a). Unlike a typical mushroom structure, *Clathraceae* species develop from a gelatinous egg into complex, hollow structures. In *Clathrus*, the gleba is dispersed over the inner surface of the receptacle or on many small, scattered glebifers that join to form a net-like lattice (Putra et al. 2025). The basidiomata are epigeous and have a thick, spongy texture (Dring 1980). They are saprobic and most diverse in tropical and subtropical regions. We follow the classification given by Hyde et al. (2024a).

Aseroe Labill., Bulletin de la Société Murithienne des Sciences Naturelles du Valais 1, 145
Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 160
Classification: *Clathraceae, Phallales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Aseroe was introduced by Labillardiere in 1806, with *A. rubra* Labill. as the type species. The type species was found solitary on the ground or on rotting wood (Cunningham 1931). The classification of *Aseroe* in GenBank and Hyde et al. (2024a) is under *Clathraceae*, whereas Species Fungorum, MycoBank, and UNITE list it under *Phallaceae* and may need updating.

The genus is distinguished by basidiomata composed of a receptacle and well-differentiated, sterile, hollow, cylindrical stipe, which arises from a white volva (Cunningham 1931, Dring 1980, Baseia & Calonge 2005). This phalloid genus is pantropical, including Africa (Kasuya 2007). Cunningham (1931) reported the presence of a diaphragm at the apex of the stem with a small central perforation. The egg shape is obovate, with a whitish to grey-brown colour, and numerous and paired awl-like branching arms can be observed from this stage (Cunningham 1931, Dring 1980). The receptacle margin branches out, and the disc, branch, or both bear mucilaginous, olivaceous, and fetid gleba on its upper surface (Dring 1980, Cunningham 1931, Baseia & Calonge 2005, Kasuya 2007). The arms are numerous, long, acute, generally paired, with numerous chambers, and expand horizontally at maturity. The origin of this species may be from the plants having arms with paired tubes (Dring 1980). Basidiospores are smooth, continuous, and elliptical (Cunningham 1931). Within *Aseroe*, Species Fungorum (2026) recognise only seven species worldwide.

Type species: *Aseroe rubra* Labill.
Other accepted species:

A. calathiscus Schltdl.
A. coccinea Imazeki & Yoshimi ex Kasuya
A. corrugata Colenso
A. genovefae Decary
A. multiradiata Zoll.
A. pallida Lloyd

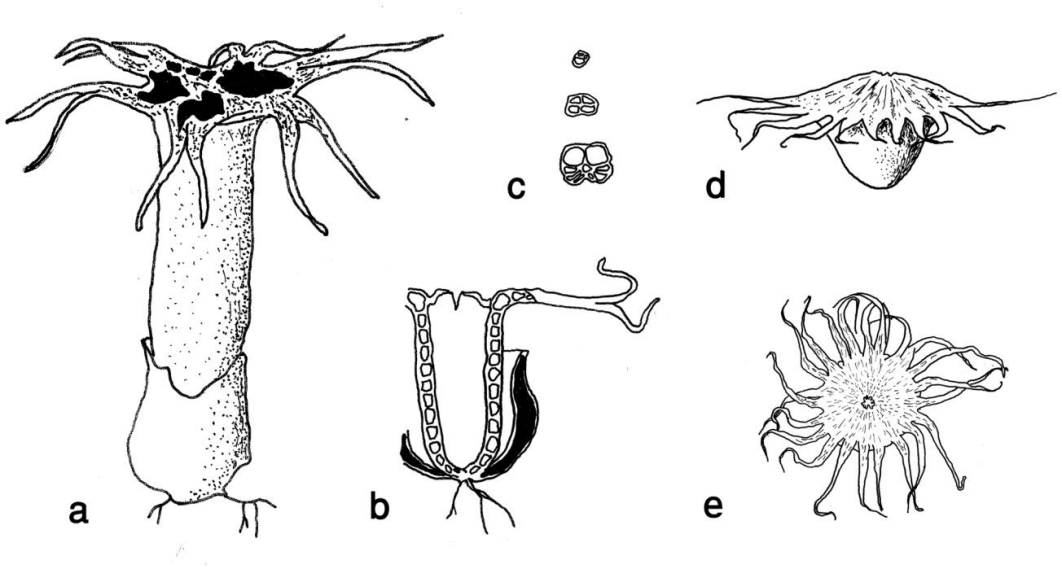


Fig. 160 – ***Aseroe rubra***. a–c *Aseroe rubra* var. *rubra*. a Carpophore. b Section of carpophore. c Section of an arm from base to apex. d, e. *Aseroe rubra* var. *junghuhnii*. Redrawn from Dring (1980).

Blumenavia Moller, Botanische Mitteilungen aus den Tropen 7, 57, 146
Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 161
Classification: *Clathraceae, Phallales, Agaricomycetes, Agaricomycotina, Basidiomycota*, *Fungi*

Blumenavia is a clathroid genus established by Alfred Moller in 1895 to accommodate *B. rhacodes* Moller (Trierveiler-Pereira et al. 2014). *Blumenavia* is also recognised by cage fungi or lattice stinkhorns (Miller & Miller 1988, Pegler & Gomez 1994, Recla et al. 2023). The etymological name of this genus was derived from Blumenau City, Santa Catarina (Brazil), where the German naturalist Alfred Moller lived (Trierveiler-Pereira et al. 2014). The classification of *Blumenavia* in Hyde et al. (2024a) is under *Clathraceae*, whereas Species Fungorum, MycoBank, GenBank, and UNITE list it under *Phallaceae* and may need updating.

Blumenavia is distinguished from other clathroids as the gleba or spore-bearing mass is spread on lateral projections and lacerations from the column occupying the external borders of the whole length of the arms, which are also called ‘wings’ or ‘teeth’ (Trierveiler-Pereira et al. 2014, Melanda et al. 2020). *Blumenavia* species typically bear a small number of columns with no transverse arms (Vargas-Rodriguez & Vazquez-Garcia 2005). Additionally, *Blumenavia* is distinct from the genus *Clathrus* Micheli ex L. as the columns are free at the base and united at their apices with membranous glebifers attached to the two inner angles of the column (Dring 1980, Sáenz 1980, Vargas-Rodriguez & Vazquez-Garcia 2005, Rodrigues & Baseia 2013). Species Fungorum (2025) reports seven records of *Blumenavia*. A recent taxonomic revision based on morphological and phylogenetic evidence (ITS, LSU, *atp6*, *rpb*2, and *tef-1α*) also reported seven species (Melanda et al. 2020, Recla et al. 2023). The morphological traits used to delimit species are basidiomata staining, number and anatomy of arms, and basidiospore dimensions (Vargas-Rodriguez & Vazquez-Garcia 2005, Melanda et al. 2020). Lloyd (1909) placed *Blumenavia* as a synonym of *Laternea* Turpin, a position followed by Rick (1961); however, most authors continued treating

Blumenavia as an independent genus (Dennis 1953, Dring 1980, López et al. 1981, Miller & Miller 1988, De Toledo 1995, Trierveiler-Pereira et al. 2014). Currently, Species Fungorum (2026) lists six species of *Blumenavia*.

Type species: *Blumenavia rhacodes* Moller

Other accepted species: (Species Fungorum – search *Blumenavia*)

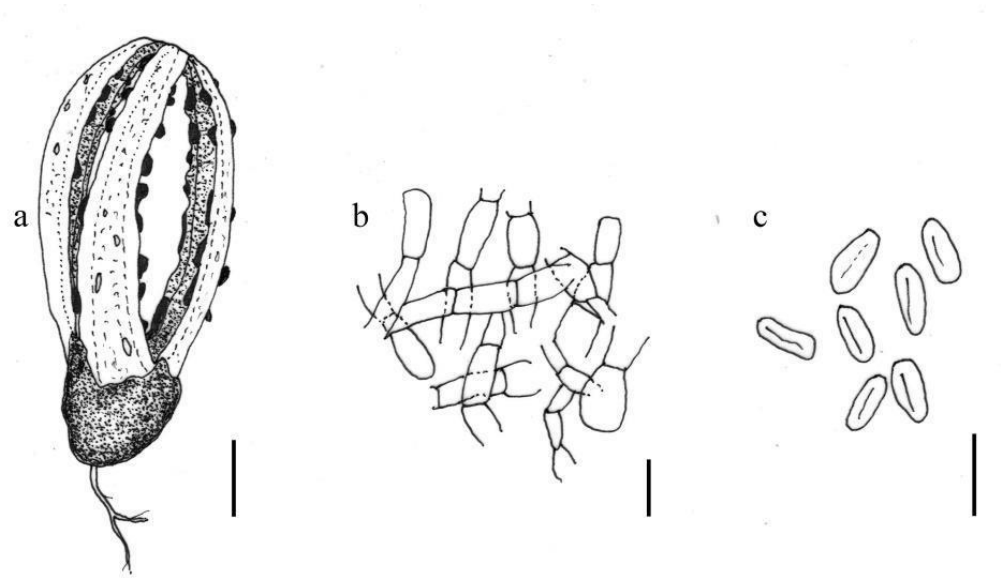


Fig. 161 – ***Blumenavia rhacodes***. a Basidiomata. b Hyphae of the apical exoperidium. c Basidiospores. Scale bar: a = 2 cm, b = 5 µm, c = 10 µm. Re-drawn: a from Trierveiler-Pereira et al. (2014), b–c from Velloso et al. (2021).

Clathrus P. Micheli ex L., Species plantarum 2, 1179

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 162

Classification: *Clathraceae, Phallales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Clathrus has been reported from different continents as widespread, especially from North Africa to Northern Europe (Dring 1980, Ivancevic & Tatic 2004, Lecuru et al. 2013). Miller & Miller (1988) and Fazolino et al. (2010) described the characteristic features of *Clathrus* as a latticed, clathrate receptacle with hollow, tubular arms that arise from basal tissue within the volva. Dring (1980) described *Clathrus* with egg sub-globose to obpyriform, cream to greyish fawn, smooth surface with reticulations; dehiscence irregular from the apex, leaving the lower meshes of the receptacle encased in a volva; sectioning shows thin peridium, gelatinous layer, traversed by conspicuous, white, peridial sutures. Receptacle obovoid, with an almost regular network of meshes, more or less isodiametric, with distinct outside and inside colour. Arms are salmon pink outside, scarlet within, tapering to an extreme base, triangular in section, with frequent large openings to the exterior; context of the arms spongy with one wide inner tube, tubes irregular in diameter; gleba attached to the inner face of arms, olive green before dehiscence and changing to olive brown, odour strong like decaying meat. Basidiospores are bacilloid and almost hyaline. Flies and other insects are attracted because of the unpleasant odour, which helps in dispersal of basidiospores (Maldonada-Ramírez & Torrres-Pratts 2005, Fazolino et al. 2010). *Clathrus* has thinning of arms towards the base of the receptacle, differing from other laternoid series, which have free arms (Dring 1980). The type sample was described by Micheli (1729) from Italy.

The classification of *Clathrus* in MycoBank, GenBank, and Hyde et al. (2024a) is under *Clathraceae*, whereas Species Fungorum and UNITE list it under *Phallaceae* and may need updating. Currently, Species Fungorum (2026) lists 40 species of *Clathrus*.

Synonymy: *Anthurus* Kalchbr. & MacOwan, *Clathrella* E. Fisch., *Colonnaria* Raf., *Dycticia* Raf., *Linderia* G. Cunn., *Linderiella* G. Cunn.

Type species: *Clathrus ruber* Micheli ex Persoon

Other accepted species: (Species Fungorum – search *Clathrus*)

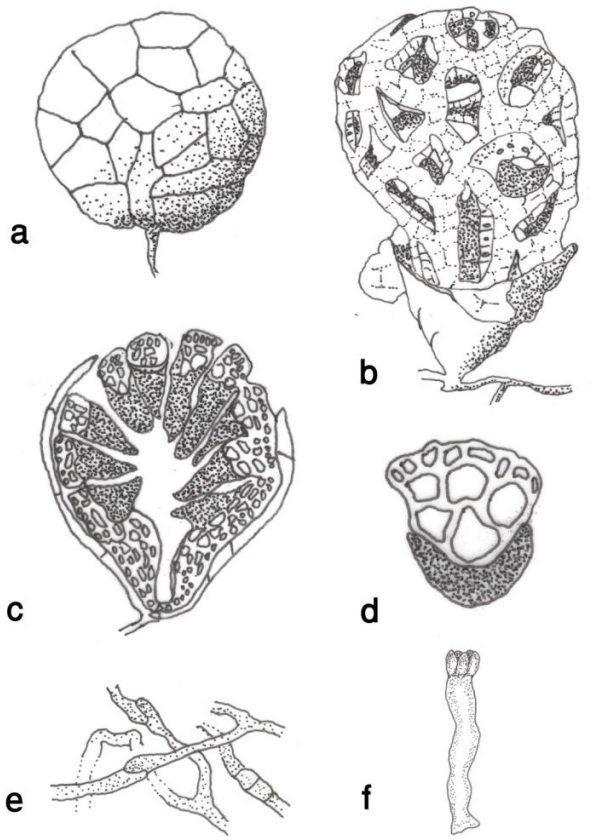


Fig. 162 – ***Clathrus ruber***. a Egg stage of basidiomata. b Mature receptacle. c Section of egg. d Diagrammatic sections of the arm with the gleba. e Hyphae in the gelatinised matrix, with occasional clamp-connection. f Basidia. Redrawn: a–d = Dring (1980), e–f = Roberts (1988).

Colus Cavalier & Sechier, Annales des Sciences Naturelles, Botanique, Série 2, 3, 253

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 163

Classification: *Clathraceae, Phallales, Agaricomycetes, Agaricomycotina, Basidiomycota*, *Fungi*

Colus is a clathroid fungus that occurs singly or in small groups, and is commonly known as cage fungi (Akata & Gurkanli 2018). The genus was introduced by Cavalier and Sechier in 1835 (Cavalier & Sechier 1835). *Colus* is saprobic and has widespread distribution (He et al. 2019).

Colus is characterised by basidiomata with a branched ovoid to pyriform receptacle, bearing a rudimentary pseudo-stipe with a whitish to greyish volva. The egg remnants form a whitish volva that remains at the base. The internal surface of the arched reticulum is covered with olive to olive-brown mucilaginous gleba. Basidiospores are ellipsoid, hyaline, and smooth (Calonge 1998, Akata & Gurkanli 2018).

Species are delineated from similar genera based on morphological characteristics and phylogenetic analysis. Phylogenetic study of an old phalloid sample, based on LSU and SSU, showed it as *Colus hirudinosus* (Melanda et al. 2021). The classification of *Colus* in Hyde et al. (2024a) is under *Clathraceae*, whereas Species Fungorum, MycoBank, GenBank, and UNITE list it under *Phallaceae* and may need updating. Currently, Species Fungorum (2026) lists seven species of *Colus*.

Type species: *Colus hirudinosus* Cavalier & Sechier
Other accepted species:
C. giganteus Dörfelt & Bumžaa
C. muelleri E. Fisch.
C. pusillus (Berk.) Reichert
C. stahelii (E. Fisch.) Reichert
C. subpusillus Dring
C. treubii (C. Bernard) Reichert

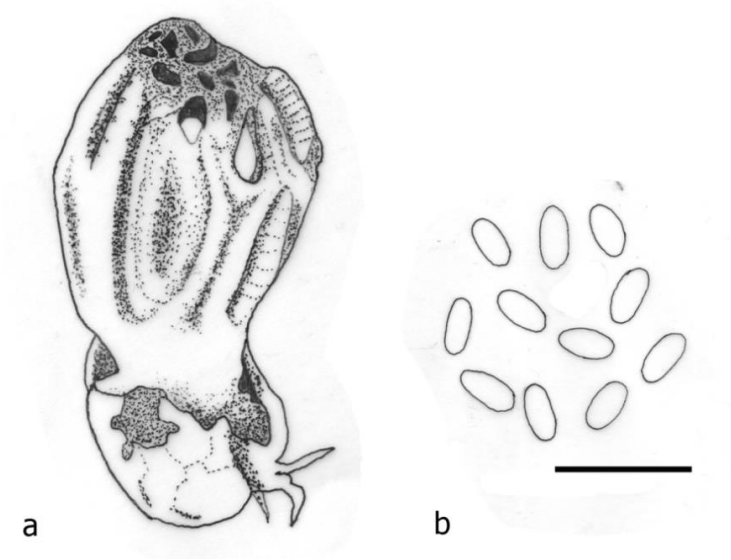


Fig. 163 – ***Colus hirudinosus***. a Mature basidiomata. b Basidiospores. Scale bar: b = 10 µm. Redrawn from Akata & Gurkanli (2018).

Laternea Turpin, in Cuvier, Dictionnaire des Sciences Naturelles 25, 248
Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 164
Classification: *Clathraceae, Phallales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Laternea was established by Turpin in 1822, with the type species *L. triscapa* Turpin (Saenz 1976). The characteristic feature of the genus is a 'lantern' suspended from the apex of the receptacle (Linder 1928, Dennis 1953b). Stipes are united above, subtend from the junction of the apices to form an angular body, and the outline of the receptacle is subovate. Columns are slender, smooth, and usually three (Linder 1928). *Laternea triscapa* has a deep orange lantern with three supporting arms (Dennis 1953b). The asexual morph of *Laternea* is unknown (He et al. 2019). An additional species *L. pusilla* is also known (Pinzon Osorio et al. 2017, He et al. 2019). The type species was collected from a sugarcane field near a forest, and *L. pusilla* was found on the ground (Dennis 1953b). The classification of *Laternea* in Hyde et al. (2024a) is under *Clathraceae*, whereas Species Fungorum, MycoBank, GenBank, and UNITE list it under *Phallaceae* and may need updating. Currently, Species Fungorum (2026) lists seven species of *Laternea*.

Type species: *Laternea triscapa* Turpin
Other accepted species:
L. brasiliensis (E. Fisch.) Long & Stouffer
L. columnata Nees
L. cristata Lloyd
L. dringii A. López, D. Martínez & J. García
L. pusilla Berk. & M.A. Curtis
L. spegazzinii Lloyd

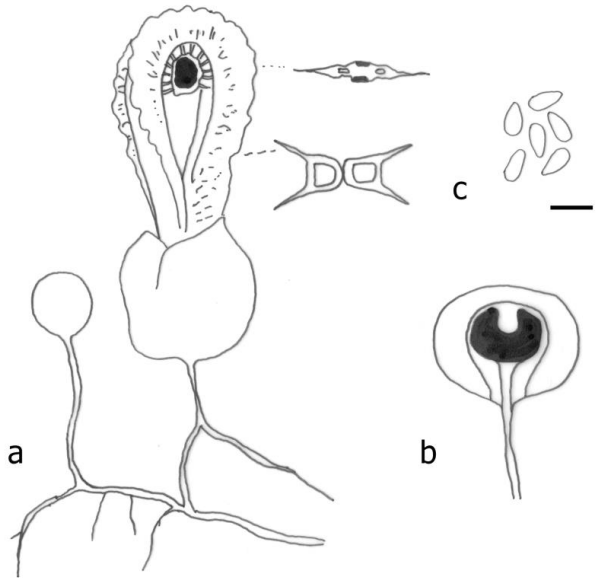


Fig. 164 – ***Laternea pusilla***. a Fructification with transverse sections of the receptacle. b Vertical section of young fruiting body. c Basidiospores. Scale bar: c = 4 µm. Redrawn from: a–b = Dennis (1953b), c = Pinzon Osorio et al. (2017).

Ligiella J. A. Sáenz, Mycologia 72(2), 338

Species Fungorum, Facesoffungi, MycoBank Fig. 165

Classification: *Clathraceae, Phallales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Ligiella was established by J.A. Saenz, consisting of a single species, *L. rodrigueziana* (Sáenz 1980). It was first described from humus and rotten wood in Costa Rica. The unopened angiocarpic fruiting body "myco-egg" is spheroid to abovoid (Sáenz 1980). The receptacle originates from a single primordial tissue and branches into arms above the rhizomorph. The receptacle consists of 4 or 5 smooth white arms that irregularly converge at the top and are free at the base. Each arm bears distinct glebiferous tissue on its inner surface. The glebiferous tissues are segmented into rough elliptical plates, and each arm is connected at the edges at the bottom. At maturity, the arms curve inward at the base. The gleba consists of dark-olive discrete bodies, and the context is permeated with prosenchymatic structures that are aromatic and non-phalloid. The fruiting bodies are interconnected by stolon-like rhizomorphs (Sáenz 1980).

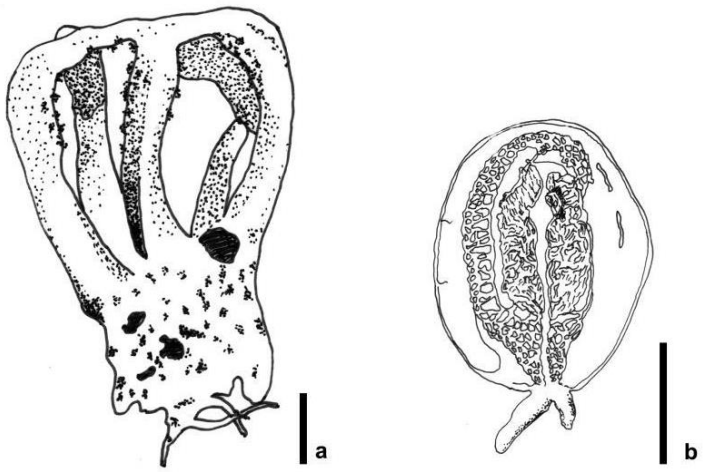


Fig. 165 – ***Ligiella rodrigueziana***. a Basidiomata. b Longitudinal section of an unopened egg. Scale bars: a–b = 1 cm. Redrawn from Sáenz (1980).

A comparative anatomical study of the form, structure, and location of the specialised glebiferous tissue, the glebiferous chamber, and gleba in *Laternea* Turpin and *Ligiella* supported the validity of *Ligiella* (Sáenz et al. 1983). Gleba is single and continuous with the internal layer of peridium in *Laternea*, whereas gleba in *Ligiella* is compound and not continuous (Sáenz 1980). *Ligiella* and *Phallus fragrans* have a medullary zone. *Ligiella* has 4–5 lateral glebiferous tissue units, whereas *Laternea* has only one glebiferous tissue at the summit (Sáenz 1980). No molecular data are available (He et al. 2019). The classification of *Ligiella* in Hyde et al. (2024a) is under *Clathraceae*, whereas Species Fungorum, MycoBank, and UNITE list it under *Phallaceae* and may need updating.

Type species: *Ligiella rodrigueziana* J. A. Sáenz

Lysuraceae Corda, Icones Fungorum Hucusque Cognitorum (Prague) 5, 28

Species Fungorum, Facesoffungi, MycoBank

Classification: *Phallales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Lysuraceae is a group of gasteroid fungi within *Phallales* E. Fisch. It was originally proposed by Corda (1842) (as "*Lysuroideae*") to accommodate the genera *Lysurus* Fr. (type genus) and *Aseroë* Labill. For most of the time, this family was treated as a synonym of *Clathraceae* Chevall. (Dring 1980, Zeller 1949) until Hosaka et al. (2006) re-established it as a distinct lineage with a molecular study. The phylogenetic study revealed *Lysuraceae* is more closely related to *Phallaceae* Corda. Members of this family are saprophytic and produce epigeous, spongy, hollow basidiomata that develop from an underground egg stage (Azevedo et al. 2021, Caffot et al. 2022). Mature basidiomata are often branched, columnar, or lattice-like (Azevedo et al. 2021). Receptacle develops from a pseudostipe with a volva. Pileus often consists of 5–6 arms. A slimy, foul-smelling gleba containing basidiospores is developed on the inner surface of the receptacle or on scattered glebifers, and its strong odour attracts insects, which helps in spore dispersal. Basidiospores are ellipsoid, thin-walled, and smooth (Azevedo et al. 2021). Currently, it includes only its type genus, *Lysurus* (Hyde et al. 2024a)

Lysurus Fr., Systema Mycologicum 2(2), 279, 285

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 166

Classification: *Lysuraceae, Phallales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Lysurus is widespread, particularly in tropical regions (Kirk et al. 2008, Gogoi & Parkash 2015, He et al. 2019). It is saprobe (Schaffer 1975, Lodge & Cantrell 1995, Abrar et al. 2013). ITS sequences are used for phylogenetic analysis of species (Hernandez Caffot et al. 2022). The genus includes species with hypogeous to sub-hypogeous immature stages (Hernandez Caffot et al. 2022). The characteristic feature of the genus is its morphology with short columnar arms attached at the apex of a cylindrical receptacle (Fischer 1886, Teng 1996, Abrar et al. 2013). The receptacle emerges from a ruptured peridium (Zang & Peterson 1989, Abrar et al. 2013). Later, the lateral surface of mature receptacle arms bears the gleba that produces a fetid odour (Miller Jr et al. 1991, Beltrán-Tejera et al. 1998, Cortez et al. 2011, Burk et al. 1982, Abrar et al. 2013). Insects and other invertebrates are attracted to this slimy gleba, which helps spore dispersal (Oliveira & Morato 2000, Johnson & Jürgens 2010, Teichert et al. 2012, Pudil et al. 2014, Hernandez Caffot et al. 2022). Abrar et al. (2013) studied developmental characters of *Lysurus*, along with morphology and taxonomic characteristics. The common name of *Lysurus cruciatus* is lizard's claw stinkhorn in the USA (Arora 1986, Abrar et al. 2013). The classification of *Lysurus* in Hyde et al. (2024a) is under *Lysuraceae*, whereas Species Fungorum, MycoBank, and UNITE list it under *Phallaceae* and may need updating. Currently, Species Fungorum (2026) lists 18 species of *Lysurus*.

Synonymy: *Aserophallus* Lepr. & Mont., *Desmaturus* (Schltdl.) Kalchbr., *Dictyobole* G.F. Atk. & Long, *Foetidaria* A. St.-Hil., *Kalchbrennera* Berk., *Kupsura* Lloyd, *Lloydia* C.H. Chow, *Lysurus* sect. *Desmaturus* Schltdl., *Lysurus* sect. *Schizmaturus* Corda, *Mycopharus* Petch, *Pharus* Petch, *Schizmaturus* (Corda) Kalchbr., *Simblum* Klotzsch ex Hook., *Sinolloydia* C.H. Chow

Type species: *Lysurus mokusin* (L. f.) Fr
Basionym: *Phallus mokusin* L. f.
Other accepted species: (Species Fungorum – search *Lysurus*)

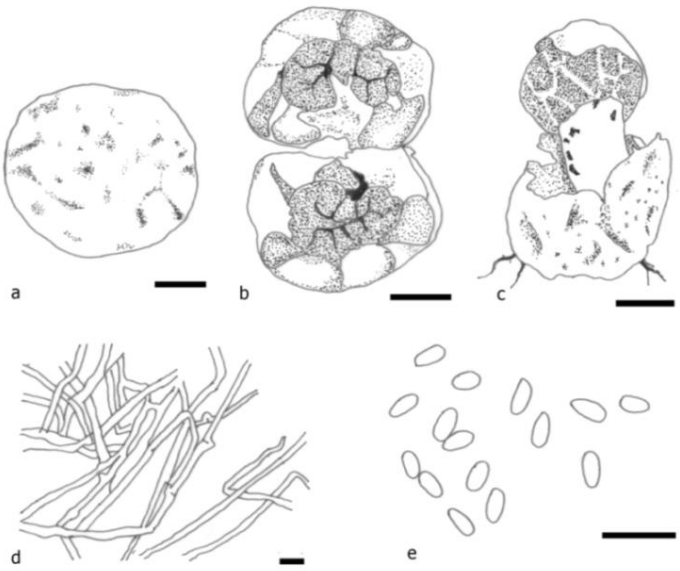


Fig. 166 – ***Lysurus fossatii***. a External view of the immature stage 'egg-like structure'. b Longitudinal section of the immature stage. c Emerging basidiome. d Clamped hyphae from the mucilage layer. e Basidiospores. Scale bar: a–c = 1 cm, d–e = 1 µm. Redrawn from Hernandez Caffot et al. (2022).

Phallaceae Corda, Icones Fungorum Hucusque Cognitorum (Prague) 5, 29
Species Fungorum, Facesoffungi, MycoBank, GenBank
Classification: *Phallales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Phallaceae was established by A.C.J. Corda (1842) and typified with *Phallus* Junius ex L. (Corda 1842). The family consists of 11 genera: *Aporophallus* Möller, *Aserocybe* Lév., *Echinophallus* Henn., *Endophallus* M. Zang & R.H. Petersen, *Itajahya* Möller, *Mutinus* Fr., *Phallus*, *Staheliomyces* E. Fisch., *Staurophallus* Mont., *Stephanophallus* MacOwan, and *Xylophallus* (Schltdl.) E. Fisch. (He et al. 2024, Hyde et al. 2024a). Species of *Phallaceae* are characterised by pseudostipitate basidiomata, with an unbranched apical part (Corda 1842, Melanda et al. 2021). Members of this family are distributed worldwide and are terrestrial and saprotrophic (He et al. 2019). Some species are considered edible, including *Phallus fragrans* M. Zang (Dai et al. 2010).

Echinophallus Henn., Botanische Jahrbücher für Systematik, Pflanzengeschichte und Pflanzengeographie 25, 505
Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 167
Classification: *Phallaceae, Phallales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Echinophallus is a genus belonging to *Phallaceae. Echinophallus* was established by Hennings in 1898 to accommodate the terrestrial fungus, *E. lauterbachii* (He et al. 2019). *Echinophallus* is a phalloid and monotypic genus that is distinctive in bearing spinulose volva and unextended stipes (Kobayasi 1937). *Echinophallus* is a primitive type because the basidiomata remain an egg, even at maturity (Kobayasi 1937). Species Fungorum (2025) reports three records of *Echinophallus*, whereas Wijayawardene et al. (2022) accepted only one species. No molecular evidence is available for the genus in GenBank (NCBI 2024). The classification of *Echinophallus* in *Phallaceae, Phallales, Agaricomycetidae, Agaricomycetes, Agaricomycotina*, and *Basidiomycota*

is in agreement in Species Fungorum, MycoBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Type species: *Echinophallus lauterbachii* (Henn.) Henn.

Basionym: *Ithyphallus lauterbachii* Henn.

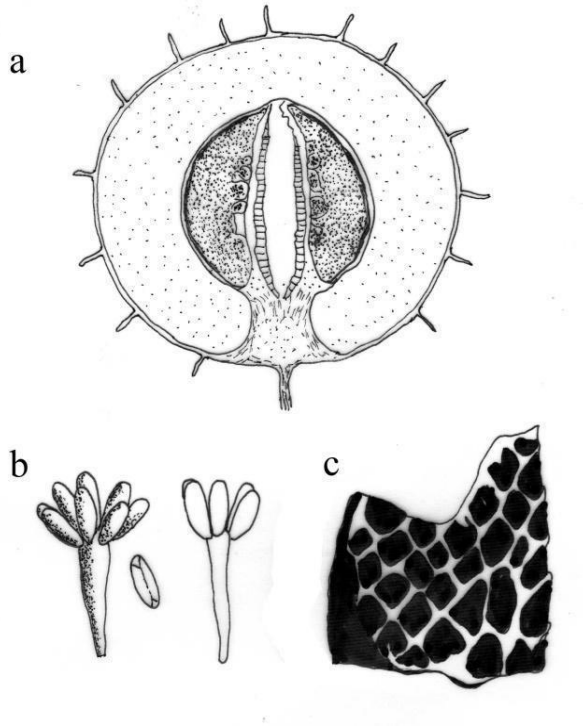


Fig. 167 – ***Echinophallus lauterbachii***. a Section of basidiomata (×5). b Basidia and basidiospores (×3000). c Part of the pileus showing a reticulated surface (×11). Redrawn from Kobayasi (1937).

Endophallus M. Zang & R.H. Petersen, Mycologia 81(3), 488

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 168

Classification: *Phallaceae, Phallales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Endophallus is a monotypic genus, with *E. yunnanensis* as the type species, described in *Phallaceae* Corda by Zang & Petersen (Zang & Peterson 1989, Wijayawardene et al. 2022). The name of the genus was derived from the word "*endo*", meaning within, and "*phallus*", from the genus *Phallus* Junius ex L. (Zang & Peterson 1989). The genus is usually buried in soil, on the ground, commonly among decaying twigs and leaves of *Phyllostachys bambusoides* (Zang & Peterson 1989). It was originally described from Yunnan, southern China, and later considered as endemic (Zang & Petersen 1989, Kreisel 1996). The classification of *Endophallus* in *Phallaceae, Phallales, Agaricomycetidae, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* is in agreement in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Basidiomata of *Endophallus* are solitary or gregarious, bearing a conical or campanulate, rugulose, irregularly somewhat vaguely reticulated pileus, with a usually perforated apex, and a pseudoparenchymatous pendent membrane usually attached to the surface (Zang & Petersen 1989, Kreisel 1996). The pileus is attached to a hollow, cylindrical, or fusoid receptacle having a characteristic discoid base. It has a soft, slightly fleshy peridium that is connected to the discoid stipe base, breaking away at maturity. The peridium is composed of three layers: the outer white, glabrous exoperidium, which is a tenuous membrane of woven hyphae, the middle thick and gelatinous mesoperidium, and the innermost delicate endoperidium. Basidia are elongate-clavate,

bearing 4–10 spores on a short sterigma. Basidiospores are elongate-ellipsoid, smooth, hyaline or olivaceous (Zang & Petersen 1989).

Kreisel (1996) redefined the infrageneric taxonomy of *Phallus* using various characters such as the shape and surface configuration of the pileus, and yellow to red pigments (carotenoids) in the receptaculum, etc., which helped him to give *Endophallus* the status of a subgenus in *Phallus* sensu lato. The genus is considered monotypic and occurs worldwide (Kreisel 1996, Wijayawardene et al. 2022). The genus was separated from *Phallus* Junius ex L., mainly based on the presence of a clearly distinct disk-shaped (discoid) receptacle base (Zang & Peterson 1989). *Endophallus yunnanensis* appears similar to *P. fragrans* M. Zang due to its non-foetid, sweet, fragrant gleba, but the basidiomata have a shorter receptacle with a discoid base, whereas *Phallus fragrans* has a longer receptacle, lacking the discoid base (Zang & Ji 1984).

Type species: *Endophallus yunnanensis* M. Zang & R.H. Petersen

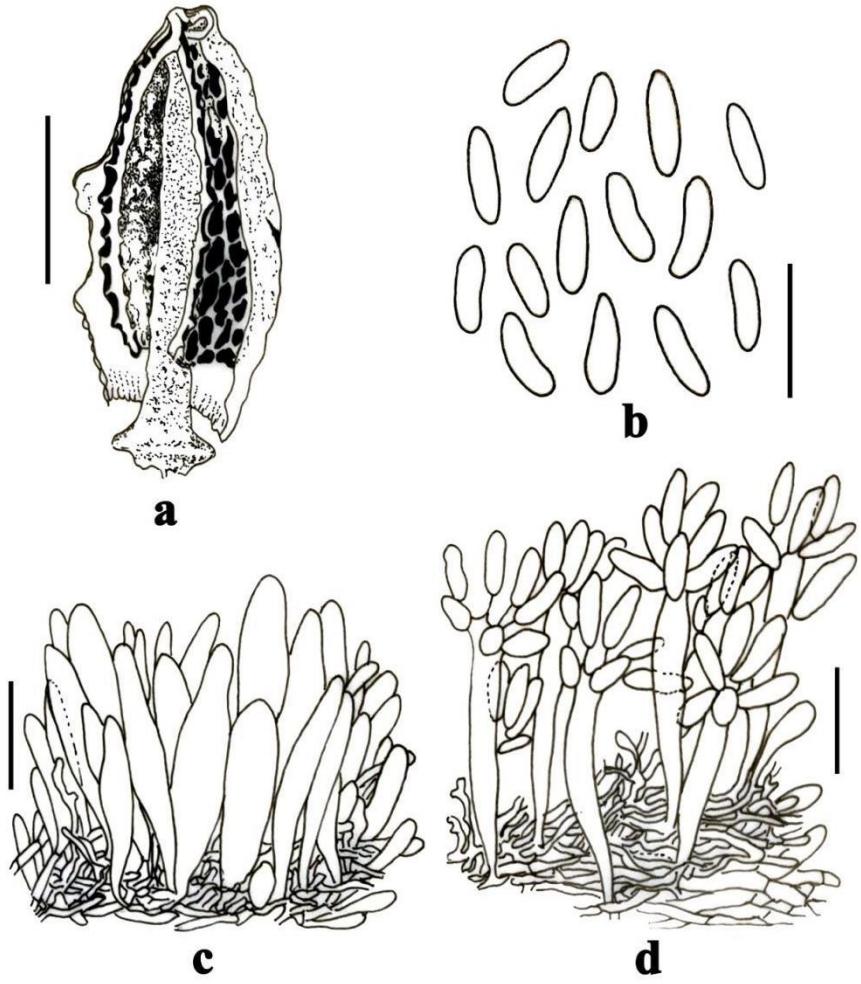


Fig. 168 – ***Endophallus yunnanensis*** (HKAS 20514, holotype). a Basidiomata. b Basidiospores. c Hymenial surface vegetative cells. d Basidia. Scale bars: a = 3 cm, b–d = 10 µm. Redrawn from Zang & Petersen (1989).

Mutinus Fr., Summa vegetabilium Scandinaviae, Sectio Posterior (Stockholm), 434

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 169

Classification: *Phallaceae, Phallales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Mutinus is characterised by its globose to ovoid, white to yellowish immature basidiome with basal attachment by white rhizomorphs (Hosaka et al. 2006). Inside, it has a mucilaginous layer that splits into two or three lobes at the apex and eventually collapses against the base of the spongy

pseudostipe. The pseudostipe is cylindrical to fusiform, hollow, and either perforated or not at the tip (Hosaka et al. 2006). The apical portion of the pseudostipe is covered by a mucilaginous gleba, and the basidiospores are elliptical and smooth (Bottomley 1948, Dring 1964, Liu 1984, Pegler et al. 1995, Calonge 1998). Cunningham (1944) divided *Mutinus* into three sections: *Granulosi*, *Tuberculosi*, and *Glabrosi*. *Granulosi* has a fertile portion with irregular pseudoparenchymatous processes that seem pseudo-reticulate, whilst *Tuberculosi* has a fertile portion covered in digitate processes. *Glabrosi* is characterised by a smooth or rugulose fertile portion (Cunningham 1944). Zhou et al. (2023e) used morphology and multiple genes (LSU, *atp6,* and *rpb2*) to identify species within *Mutinus*. The classification of *Mutinus* in *Phallaceae, Phallales, Agaricomycetidae, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* is in agreement in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a). Currently, Species Fungorum (2026) lists 33 species of *Mutinus*.

Synonymy: *Aedycia* Raf., *Corynites* Berk. & M.A. Curtis, *Cynophallus* (Fr.) Corda, *Floccomutinus* Henn., *Ithyphallus* Gray, *Jansia* Penz., *Phallus* trib. *Cynophallus* Fr.

Type species: *Mutinus caninus* (Schaeff.) Fr.

Basionym: *Phallus caninus* Schaeff.

Other accepted species: (Species Fungorum – *Mutinus*)

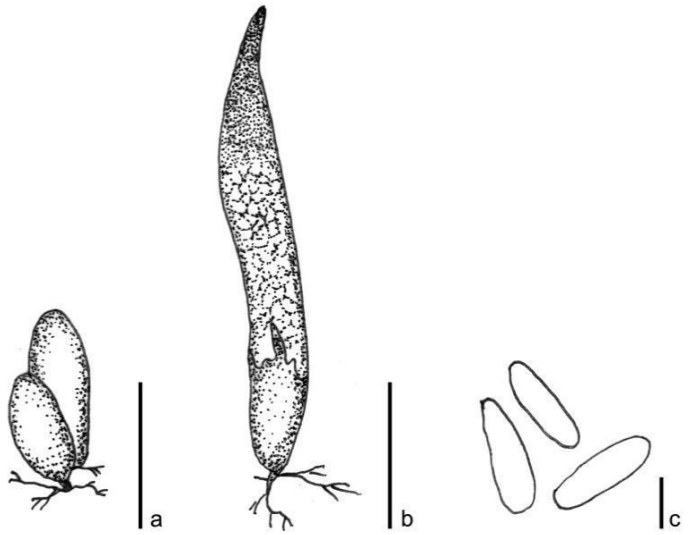


Fig. 169 – ***Mutinus caninus***. a Immature basidiomata. b Mature basidiomata. c Basidiospores. Scale bars: a–b = 2 cm, c = 2 μm. Redrawn from Magnago et al. (2013).

Phallus Junius ex L., Species plantarum 2, 1178

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 170

Classification: *Phallaceae, Phallales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Phallus was established by Junius in 1753, with *P. impudicus* L. as the type species. *Phallus* was regarded as a gasteroid genus commonly known as the stinkhorn fungus. *Phallus* species are phylogenetically analysed and described using combined ITS, LSU, and *atp6* to compare at the inter- and intra-species level (Cabral et al. 2019, Sommai et al. 2021). The classification of *Phallus* in *Phallaceae, Phallales, Agaricomycetidae, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* is in agreement in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a). Currently, Species Fungorum (2026) lists 73 species of *Phallus*.

Phallus is a distinctive genus in *Phallaceae* that produces a net-like veil, varying in colours, such as white, orange, pink, and grey (Fulton 1889, Li et al. 2016, Cabral et al. 2019). Basidiomata are globose to ovoid, white, soft, and with mycelial cords (Calonge 1998, Moreno et al. 2009,

Yakar & Yasin 2019). Exoperidium is smooth and membranous, while endoperidium is gelatinous and translucent. Pseudostipe, when mature, is cylindrical, erect to curved, hollow, white, spongy, and fragile with conical, mucilaginous, foetid, olive brown, nearly half-rounded receptacle (gleba) at the apex and is attached with a stout, white mycelial cord (Calonge 1998, Moreno et al. 2009, Li et al. 2016, Yakar & Yasin 2019, Sommai et al. 2021). Basidia are clavate and 6-spored (Yakar & Yasin 2019). Spores are ellipsoid with a pale yellowish green colour and have a smooth surface (Calonge 1998, Moreno et al. 2009).

Members of *Phallus* are distributed worldwide (He et al. 2019). The genus is reported growing in rich humus soil, littoral dunes, and fallen decaying hardwood and coniferous forest (Moreno et al. 2009, Rebriev et al. 2014, Yakar & Yasin 2019). Many species of *Phallus* have been used for centuries and have health benefits such as antioxidant, antimicrobial, immunomodulatory, organoprotective, anticancer, anti-diabetic, and anti-obesity effects (Wang et al. 2021, Mazumder et al. 2022).

Synonymy: *Clautriavia* (Pat.) Lloyd, *Cryptophallus* Peck, *Dictyopeplos* Kuhl & Hasselt, *Dictyophallus* Corda, *Dictyophora* Desv., *Dictyophora* sect. *Clautriavia* Pat., *Hymenophallus* Nees, *Jaczewskia* Mattir., *Junia* Dumort., *Kirchbaumia* Schulzer, *Leiophallus* (Fr.) Nees, *Morellus* Eaton, *Omphalophallus* Kalchbr., *Phallus* sect. *Dictyophora* (Desv.) Kreisel, *Phallus* trib. *Leiophallus* Fr., *Retigerus* Raddi, *Satyrus* Bosc, *Sophronia* Pers.

Type species: *Phallus impudicus* L.

Other accepted species: (Species Fungorum – search *Phallus*)

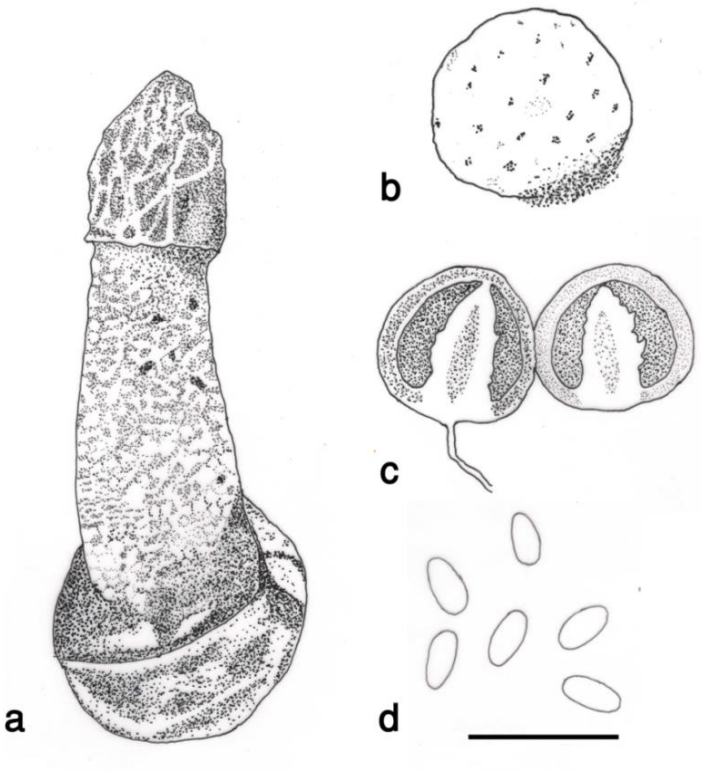


Fig. 170 – ***Phallus impudicus***. a–c Basidiomata. d Basidiospores. Scale bar: d = 10 µm. Redrawn from Yakar & Yasin (2019).

Phallales genera incertae sedis

Endoclathrus B. Liu, Yin H. Liu & Z.J. Gu, Journal of Shanxi University, Natural Science 23(4), 345

Species Fungorum, Facesoffungi, MycoBank Fig. 171

Classification: *Incertae sedis, Phallales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Endoclathrus is a monotypic genus established by B. Liu, Y.H. Liu & Z.J. Gu in 2000 within *Phallaceae* Corda, with *E. panzhihuaensis* as the type species. It was described based on a specimen collected from forest floors, dominated by *Pinus densiflora* and *P. yunnanensis,* in Sichuan Province, China (Bo et al. 2000).

Members of *Endoclathrus* are characterised by regularly spherical hollow basidiomata, apricot-red when fresh, light-brown when dry, and a basal rhizomorph (Bo et al. 2000). The peridium is soft, never splitting after maturation, strongly six-angled reticulated lattices, and composed of three layers: tenuous exoperidium of woven hyphae, gelatinous mesoperidium, and membranous endoperidium of woven hyphae. The receptacles are clathrate, sessile, and closely connected with the internal surface of the endoperidium. Basidiospores are elongate-ellipsoid and hyaline to slightly olivaceous (Bo et al. 2000).

No molecular sequence data for *Endoclathrus* are available, which limits phylogenetic placement and comparative genomic studies (He et al. 2019). The classification of *Endoclathrus* in Hyde et al. (2024a) is under *incertae sedis*, whereas Species Fungorum, MycoBank, GenBank, and UNITE list it under *Phallaceae* and may need updating.

Endoclathrus is distinct from other genera in *Clatharaceae* by its never splitting peridium and its closely connected receptacle with the internal surface of the endoperidium (Bo et al. 2000).

Type species: *Endoclathrus panzhihuaensis* B. Liu, Yin H. Liu & Z.J. Gu.

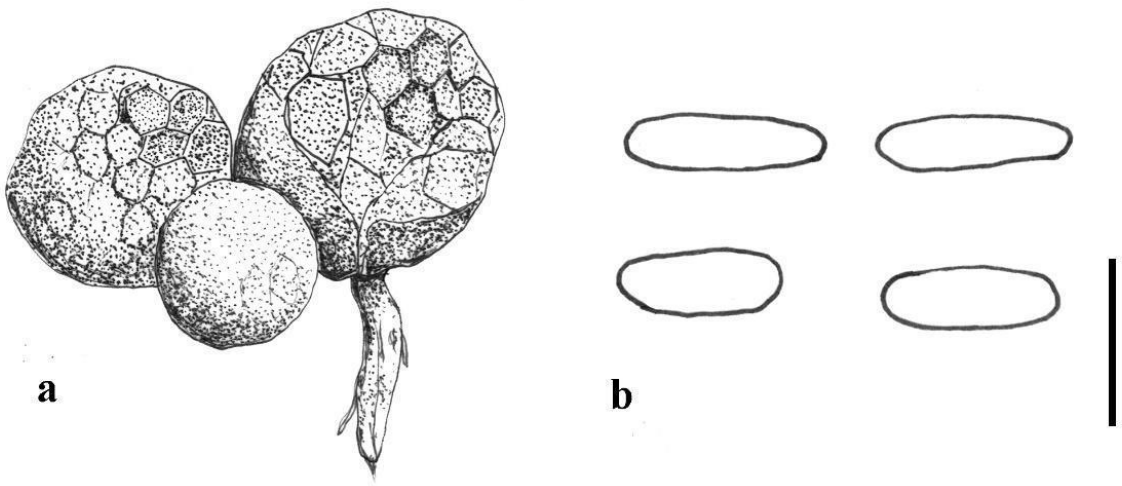


Fig. 171 – ***Endoclathrus panzhihuaensis***. a Basidiomata. b Basidiospores. Scale bar: b = 5 µm. Redrawn from Bo et al. (2000). For original basidiomata, refer to Liu et al. (2000).

Neolysurus O.K. Mill., Ovrebo & Burk, Mycological Research 95(10), 1230

Species Fungorum, Facesoffungi, MycoBank

Classification: *Incertae sedis, Phallales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Neolysurus is a monotypic genus described by Miller Jr in 1991, with the type species *N. arcipulvinus* described from Costa Rica (Miller Jr et al. 1991). It is characterised by a tubular stipe and apical anastomosing arms resembling those of *Colus* Cavalier & Séchier and *Lysurus* Fr. The species characteristics include a long stipe, terminating in a cushion-shaped, pulvinate olive-green gleba at the apex, which is divided into polygonal compartments by a fine, pinkish-white, solid mesh. The hymenium is spread across these mesh partitions (Miller Jr et al. 1991). *Neolysurus* belongs to the gasteroid basidiomycetes and is classified within the *Lysuroid* series (Pegler & Gomez 1994, Trierveiler-Pereira et al. 2013).

Neolysurus is closely related to *Linderiella* G. Cunn.; however, the former has a well-developed, tubular pseudostipe and a gleba of different construction (Pegler & Gomez 1994). Despite its distinct morphology, the genus requires further investigation supported by molecular sequence data to clarify its phylogenetic placement (He et al. 2019). The classification of *Neolysurus* as *Phallaceae, Phallales, Phallomycetidae, Agaricomycetes, Agaricomycotina, Basidiomycota,* is in agreement with Species Fungorum, He et al. (2019), and Wijayawardene et al. (2022). However, the genus has been reclassified under *Phallales* genera *incertae sedis* (He et al. 2024, Hyde et al. 2024a).

Type species: *Neolysurus arcipulvinus* O.K. Mill., Ovrebo & Burk

Pseudoclathrus B. Liu & Y.S. Bau, Mycotaxon 10(2), 293

Species Fungorum, Facesoffungi, MycoBank Fig. 172

Classification: *Incertae sedis, Phallales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Pseudoclathrus was established as a new genus under *Clathraceae* in 1980 with type species *P. cylindrosporus* B. Liu & Y.S. Bau (Liu & Sun 1980). However, recently the genus has been categorised under *Phallaceae* Corda (He et al. 2019). The members are found growing terrestrially along forest margins, with the greatest distribution in the Asian continent, particularly in China (Liu & Sun 1980, Zou et al. 2008).

The genus is characterised by stipitate basidiomata, a receptacle formed by erect ramifications (arms or laciniae) of equal diameter (Liu & Sun 1980). A longitudinal sulcus (furrows) is present on the abaxial side of each of the ramifications. Individual ramified branches unite at their apices. Basidiospores are cylindrical in shape. This genus was previously reported, showing similarities with *Clathrus columnatus* Bosc and *Lysurus mokusin* (L. f.) Fr. (Liu & Sun 1980). However, *Clathrus* P. Micheli ex L. lacks a longitudinal sulcus both on the arms and the stipe. *Pseudoclathrus* differs from *Lysurus* Fr. in having an amphi-complanate type of stipe (Liu & Sun 1980).

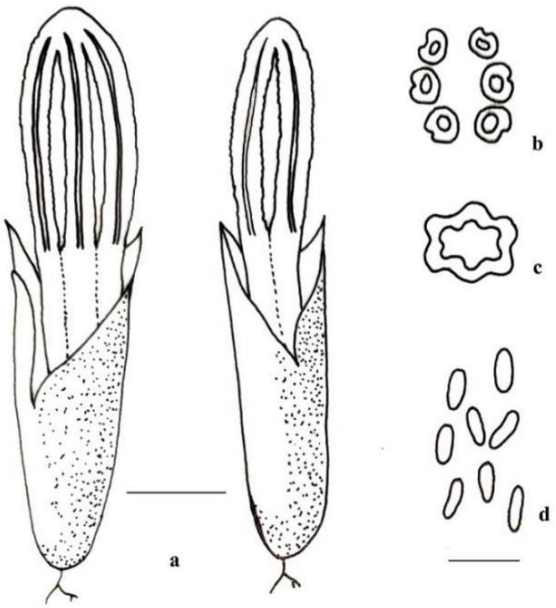


Fig. 172 – ***Pseudoclathrus cylindrosporus*** (holotype). a Basidiomata. b Cross-section of arms representing furrows. c Cross-section of stipe showing ridges. d Basidiospores. Scale bars: a = 1 cm, b–d = 6 µm. Redrawn from Liu & Sun (1980).

The classification of *Pseudoclathrus* in He et al. (2024) and Hyde et al. (2024a) is under *Phallales* genera *incertae sedis*, whereas Species Fungorum, MycoBank, and UNITE list it under *Phallaceae* and may need updating. Currently, Species Fungorum (2026) lists four species of *Pseudoclathrus*.

The genus comprises four species worldwide (Hyde et al. 2024a). The type species, *P. cylindrosporus,* was collected from the western hill of Peking (Liu & Sun 1980). To date, no molecular studies have been conducted on the genus.

Type species: *Pseudoclathrus cylindrosporus* B. Liu & Y.S. Bau

Other accepted species:

P. anshunensis W. Zhou & K.Q. Zhang

P. leigongshanensis W. Zhou & K.Q. Zhang

P. pentabrachiatus F.L. Zou, G.C. Pan & Y.C. Zou

Cantharellales Gäum., Vergleichende Morphologie der Pilze (Jena), 495

Species Fungorum, Facesoffungi, MycoBank, GenBank

Aphelariaceae Corner, Beihefte zur Nova Hedwigia 33, 5

Species Fungorum, Facesoffungi, MycoBank

Classification: *Cantharellales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Aphelariaceae was established by Corner in 1970, and typified by the genus *Aphelaria* Corner (Corner 1950). The family includes three genera, *Aphelaria*, *Phaeoaphelaria* Corner, and *Tumidapexus* D.A. Crawford (Hyde et al. 2024a). *Aphelariaceae* is characterised by orthotropic, branched basidiomata, with rounded or flattened fertile branches and a sterile base, presence of monomitic hyphal system, and ellipsoidal or drop-shaped, smooth, in amyloid basidiospores. Members of the family are saprobic, occurring in soil or wood (Bondartseva & Zmitrovich 2023).

Aphelaria Corner, Monograph of *Clavaria* and allied Genera (Annals of Botany Memoirs No. 1), 180, 690

Species Fungorum, Facesoffungi, MycoBank Fig. 173

Classification: *Aphelariaceae, Cantharellales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Aphelaria, a genus within clavarioid fungi, was established by E.J.H. Corner in 1950 and typified with *A. dendroides* (Jungh.) Corner (Corner 1950). The first description of *A. dendroides* was based on specimens collected from soil in forests in Java, Indonesia (Junghuhnius 1838); however, species of *Aphelaria* are widespread in distribution (He et al. 2019). Within *Aphelaria,* Hyde et al. (2024a) recognised approximately 20 species worldwide. *Aphelaria* is characterised by tough, consistent basidiomata, flattened branching, and hyaline basidiospores (Corner 1950). This genus was divided into two subgenera: *Aphelaria* with normal clavarioid basidia with clamped hyphae, and subgenus *Tremellodendropsis* with subtremellaceous basidia and without clamps (Corner 1953). Crawford (1954) elevated *Tremellodendropsis* to genus level, introducing the new species *T. transpusio* D.A. Crawford.

Basidiomata of *Aphelaria* are usually sub-sessile, branched, and covered with a hard, pale mealy-crustaceous bark on the outside (Junghuhnius 1838). Basidia are typically clavate, generally with four sterigmata (Corner 1966). Basidiospores are smooth, thin-walled, ellipsoid to subcylindrical. Cystidia are lacking. The hyphal system is monomitic (Corner 1966). Identification of *Anastrophella* species is solely based on morphological characteristics, as no molecular evidence has been reported (He et al. 2019). The classification of *Aphelaria* in *Aphelariaceae, Cantharellales, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* agrees in Species Fungorum, MycoBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Type species: *Aphelaria dendroides* (Jungh.) Corner

Basionym: *Clavaria dendroides* Jungh.

Other accepted species: (Species Fungorum – search *Aphelaria*)

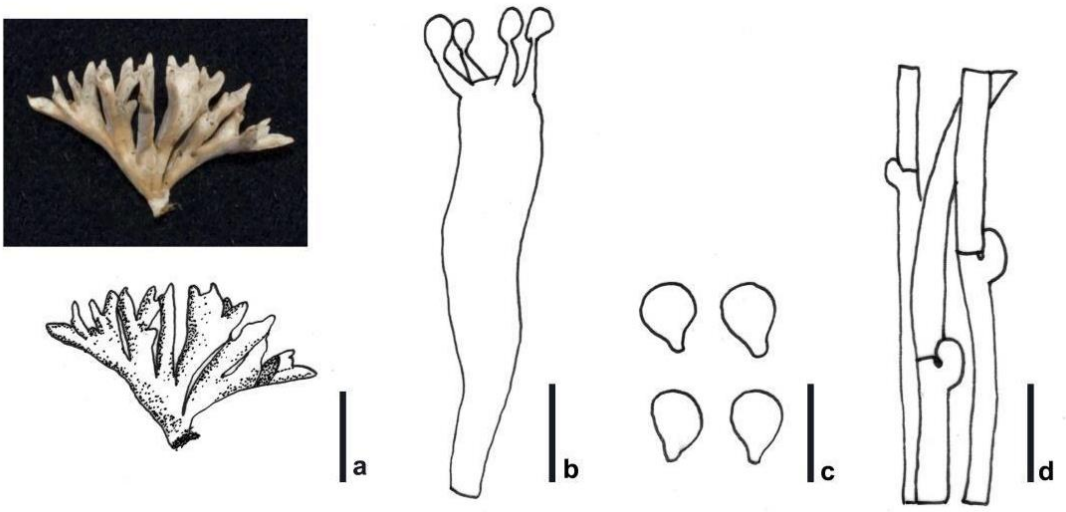


Fig. 173 – ***Aphelaria subglobispora*** (a = DED8317, b–d = K(M) 58046). a Basidiomata. b Basidia. c Basidiospores. d Clamped, inflated hyphae. Scale bar: a = 1 cm, b–d = 10 µm. Redrawn from Desjardin & Perry (2015) and Roberts (1999).

Hydnaceae Chevall., Flore Générale des Environs de Paris 1, 270

Species Fungorum, Facesoffungi, MycoBank, GenBank

Classification: *Cantharellales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Hydnaceae is a diverse family established by F.F. Chevallier (1826), with *Hydnum* L. as the type genus (Chevallier 1826). The family consists of 25 genera: *Bergerella* Diederich & Lawrey, *Bryoclavula* H. Masumoto & Y. Degawa, *Burgella* Diederich & Lawrey, *Burgellopsis* Diederich & Lawrey, *Burgoa* Goid., *Cantharellus* Adans. ex Fr., *Clavulina* J. Schrot., *Corallofungus* Kobayasi, *Craterellus* Pers., *Gloeomucro* R.H. Petersen, *Hydnum*, *Ingoldiella* D.E. Shaw, *Membranomyces* Jülich, *Minimedusa* Weresub & P.M. LeClair, *Multiclavula* R.H. Petersen, *Neoburgoa* Diederich, E. Zimm. & Lawrey, *Osteomorpha* G. Arnaud ex Watling & W.B. Kendr., *Parmeliicida* Diederich, F. Berger, Etayo & Lawrey, *Parastereopsis* Corner, *Paullicorticium* J. Erikss., *Repetobasidiellum* J. Erikss. & Hjortstam, *Rogersiomyces* J.L. Crane & Schokn., *Scotomyces* Jülich, *Sistotrema* Fr., and *Sistotremella* Hjortstam (Hyde et al. 2024a). *Hydnaceae* produce complex fleshy basidiomata and are diverse in forms, such as cantharelloid, hydnoid, polyporoid, and clavarioid (Cao et al. 2021, He et al. 2024). The basidia are stichic, with more than four sterigmata (Cao et al. 2021). Members of the family are distributed worldwide and are predominantly ectomycorrhizal (He et al. 2024). Notably, species of *Bryoclavula* and *Multiclavula* form lichens in association with algae (Cao et al. 2021). Some genera of the family produce edible mushrooms, including *Cantharellus*, *Craterellus*, and *Hydnum* (He et al. 2024).

Burgella Diederich & Lawrey, Mycological Progress 6(2), 62

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 174

Classification: *Hydnaceae, Cantharellales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Burgella was described by Diederich and Lawrey to accommodate *B. flavoparmeliae* as its type species (Diederich & Lawrey 2007). *Burgella* is distributed in various regions, including Argentina, Bolivia, and the USA, where it grows on lichens, such as *Flavoparmelia baltimorensis*, *Sticta weigelii*, *Heterodermia* species, and *cf. Pertusaria* species (Diederich & Lawrey 2007, Diederich et al. 2014). Currently, Species Fungorum (2026) lists five species of *Burgella*.

Colonies of *Burgella* are characterised by honey-coloured bulbils that are either dispersed or rarely agglomerated. These bulbils can be roundish, shortly ellipsoid, or irregularly shaped and may be partly immersed or superficial on their host. The surface cells are polyhedral, while internally the cells are strongly adherent and roundish to ellipsoid. Clamp connections are generally absent, and the hyphae are hyaline, septate, straight, and rarely branched or anastomosed. Septa may have clamp connections, though this varies (Diederich & Lawrey 2007). In some cases, the agglomerations of bulbils cluster to form a gelatinous, almost coralloid appearance, consisting of irregularly shaped bulbils made up of roundish or elongate cells with clamped septa on both the external and internal surfaces (Diederich & Lawrey 2007, Diederich et al. 2014).

Diederich et al. (2014) used both morphological and phylogenetic analysis (ITS and LSU) to delineate species within *Burgella*. This genus is distinct from related genera *Burgoa* Goid. and *Minimedusa* Weresub & P.M. LeClair due to its lichenicolous nature (Diederich & Lawrey 2007). *Burgoa* is host-specific and typically becomes immersed in the host lichen's thallus, leaving notable scars upon removal. In contrast, *Burgoa* and *Minimedusa* are either non-lichenicolous or facultatively lichenicolous, showing no host specificity, and do not embed themselves in the host thallus (Diederich & Lawrey 2007, Diederich et al. 2014). The classification of *Burgella* in *Hydnaceae, Cantharellales, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* agrees in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Type species: *Burgella flavoparmeliae* Diederich & Lawrey

Other accepted species:

B. albofarinacea Qian Zhou & C.L. Zhao

B. fissurata Qian Zhou & C.L. Zhao

B. lutea Diederich, Capdet, A.I. Romero & Etayo

B. yunnanensis Qian Zhou & C.L. Zhao

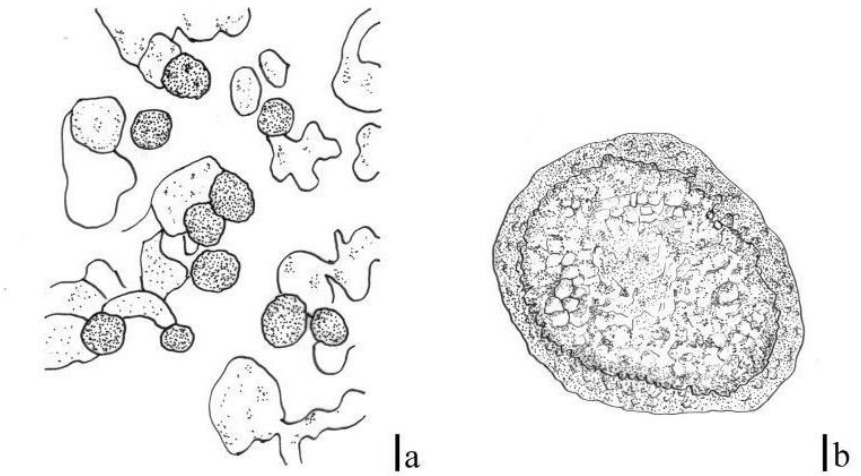


Fig. 174 – ***Burgella flavoparmeliae***. a Bulbils on the thallus of *Flavoparmelia baltimorensis*. b Bulvil in surface view. Scale bar: a = 100 µm, b = 20 µm. Redrawn from Diederich et al. (2014). For original basidiomata, refer to Diederich et al. (2014).

Burgoa Goid., Bollettino della Regia Stazione di Patologia Vegetale, Roma, Nuova Serie 17, 354

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 175

Classification: *Hydnaceae, Cantharellales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Burgoa, typified by *B. verzuoliana* Goid., is a small, microscopic, bulbil-producing genus within *Hydnaceae* Chevall. *Burgoa* is distinguished by the development of multicellular bulbils, which consist of a differentiated peridial layer surrounding internal cellular components. Beyond bulbil production, species of *Burgoa* are characterised by the presence of clamp connections in their

hyphae, a diagnostic trait supporting their affiliation with *Agaricomycotina* Doweld (Goidŕnich 1937, Lawrey et al. 2007, Koukol & Kubatova 2015, Zhou et al. 2025). Placement of the genus within *Cantharellales* Gäum. was only more recently recognised (Diederich & Lawrey 2007, Koukol & Kubátová 2015, Kiyuna et al. 2015). The classification of *Burgoa* in *Hydnaceae, Cantharellales, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* agrees in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a). Currently, Species Fungorum (2026) lists 11 species of *Burgoa*.

Unlike most taxa within *Cantharellales*, *Burgoa* represents a peculiar lineage of microscopic basidiomycetes that entirely lacks basidiomata formation. Instead, reproduction is accomplished exclusively through the production of bulbilliferous structures. Species of *Burgoa* are predominantly saprotrophic, occurring sporadically on woody substrates; however, knowledge of their ecology and distribution remains limited, largely owing to their rarity (Koukol & Kubatova 2015, Zhou et al. 2025).

Goidŕnich (1937) established *Burgoa* to encompass all then-known bulbilliferous microfungi, introducing three novel taxa (*B. alutacea* Goid., *B. hutsonii* Goid., and *B. verzuoliana* Goid.) and transferring two additional species from *Papulaspora* Preuss (*B. anomala* (Hotson) Goid. and *B. nigra* (Hotson) Goid.). Subsequently, *B. pisi* S. Qin He & D.Z. Tang was described from the roots of *Pisum sativum* (He & Tang 1998), followed by *B. turficola* G.B. Schlechte & P. Hoffm reported from peat-based growing media (Schlechte & Hoffmann 2000). Diederich & Lawrey (2007) expanded the genus with three epiphytic and lichenicolous taxa, *B. angulosa* Diederich, Lawrey & Etayo, *B. moriformis* Diederich, Ertz & Coppins, and *B. splendens* Diederich & Coppins, supported by phylogenetic evidence. Zhou et al. (2025) introduced *B. wumengshanensis* Q. Zhou & C.L. Zhao from China, occurring on a fallen angiosperm branch, based on multigene phylogenetic analyses.

Type species: *Burgoa verzuoliana* Goid.

Other accepted species: (Species Fungorum – search *Burgoa*)

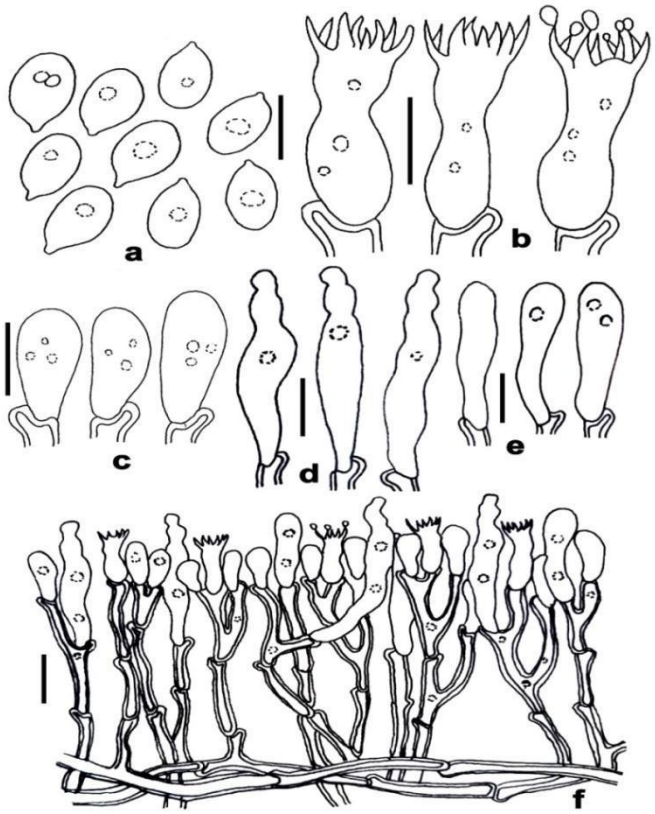


Fig. 175 – ***Burgoa wumengshanensis*** (CLZhao 33227, holotype). a Basidiospores. b Basidia. c Basidioles. d Schizopapillate cystidia. e Clavate cystidioles. f A section of the hymenium. Scale bars: a = 5 μm, b–f = 10 μm. Redrawn from Zhou et al. (2025). For original basidiomata, refer to Zhou et al. (2025).

Clavulina J. Schröt., in Cohn, Kryptogamen-Flora von Schlesien 3.1(25–32), 442

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 176

Classification*: Hydnaceae, Cantharellales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Clavulina, a coral mushroom, was introduced by J. Schröter in 1888 (Schröter 1888). This fungus is a globally distributed ectomycorrhizal fungus found in both temperate and tropical forests, thriving in deciduous and mixed woodland (Henkel et al. 2011, Njue et al. 2017, Wu et al. 2019c, Huang et al. 2023). Within *Clavulina*, Hyde et al. (2024a) recognised only 90 species worldwide. The classification of *Clavulina* in *Hydnaceae, Cantharellales, Agaricomycetidae, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* is in agreement in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Species of *Clavulina* display high morphological variability and irregular branching (Henkel et al. 2005, Njue et al. 2017). *Clavulina* basidiomata are clavarioid to coralloid, occasionally resupinate, effused, simple or branched, with colours ranging from white to grey or purple (He et al. 2016, Huang et al. 2023). The context of basidiomata is white or various colours, waxy-fibrous or rather brittle (He et al. 2016). Microscopically, the hyphal system is monomitic with clamp connections and bears incrustations or ornamentation (Corner 1950, Henkel et al. 2011, Uehling et al. 2012a, He et al. 2016, de Meiras-Ottoni & Gibertoni 2023). Basidia are cylindrical to sub-clavate, generally bear two cornute sterigmata, and often develop a transversal septum after the release of the basidiospores (Huang et al. 2023). Basidiospores are smooth, hyaline, globose to subglobose with one or several translucent guttules (Henkel et al. 2011, Felipe 2012, Wu et al. 2019c, Huang et al. 2023, de Meiras-Ottoni and Gibertoni 2023). Molecular phylogenetic analysis confirms *Clavulina* as monophyletic (Olariaga et al. 2009, Wu et al. 2019c, de Meiras-Ottoni and Gibertoni 2023). Both morphological and molecular data are used for species-level identification of *Clavulina* (He et al. 2016). Recent studies used morphology and multigene analysis (ITS, LSU, and *rpb2*) to describe new species (Eduardo et al. 2019, Wu et al. 2019c, Huang et al. 2023).

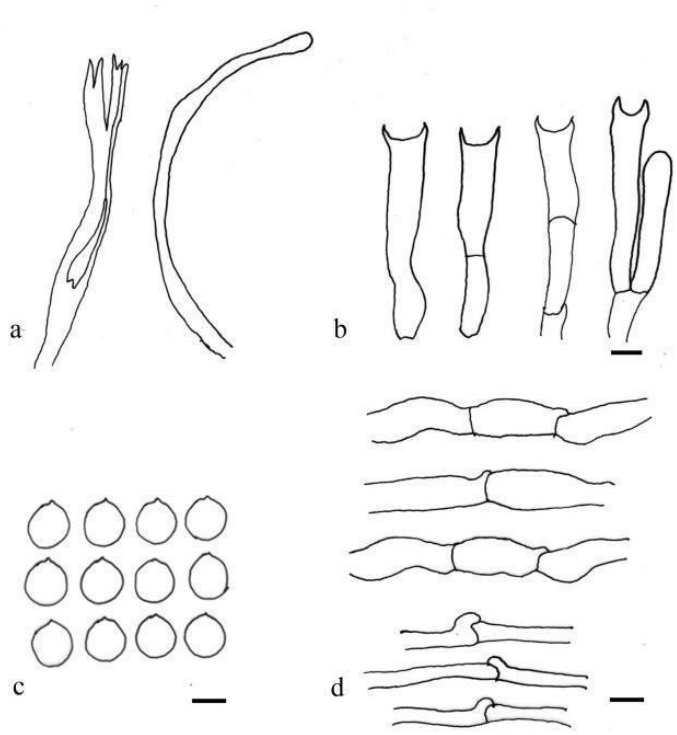


Fig. 176 – ***Clavulina livida***. a Basidiomata. b Basidia. c Basidiospores. d Hyphae. Scale bar: b−d = 10 µm. Redrawn from He et al. (2016).

Clavulina cinerea (Bull) J. Schröt is considered medicinally useful and prized as food for chronically ill people due to its rich nutritive value (Agrahar-Murugkar & Subbulakshmi 2005, Njue et al. 2017, Wu et al. 2019c). Some species have insecticidal properties against *Drosophila melanogaster* (Mier et al. 1996, Njue et al. 2017).

Synonymy: *Stichoramaria* Ulbr.

Type species: *Clavulina cristata* (Holmsk.) J. Schröt.

Basionym: *Ramaria cristata* Holmsk.

Other accepted species: (Species Fungorum – search *Clavulina*)

Corallofungus Kobayasi, Journal of Japanese Botany 58(6), 174

Species Fungorum, Facesoffungi, MycoBank Fig. 177

Classification: *Hydnaceae, Cantharellales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Corallofungus is a monotypic genus established by Yosio Kobayashi in 1983, typified by *C. hatakeyamanus* (Kobayashi 1983, Hyde et al. 2024a). The type specimen was collected from a mixed forest in Japan (Kobayashi 1983). *Corallofungus* was classified in *Aphyllophorales* Rea., due to the coralloid morphology (Kobayashi 1983). However, *Corallofungus* was reclassified under *Cantherelleles* (Bondartseva & Zmitrovich 2023). Bondartseva & Zmitrovich (2023) have raised doubts about the synonymy of this genus with *Clavulina* J. Schröt., indicating a need for modern interpretation.

He et al. (2019) reported that identification of *Corallofungus* is solely based on morphological characteristics due to the lack of molecular evidence. The basidiomata of *Corallofungus* are globose, fleshy, and fragile, initially white and becoming creamy as they mature (Kobayashi 1983). The columnar branches are covered by an irregular hymenium (Kobayashi 1983). Each basidium bears 2 or 4 sterigmata, while the basidiospores are globose and hyaline (Kobayashi 1983). Hyphae are septate and branched (Kobayashi 1983). The classification of *Corallofungus* in *Hydnaceae, Cantharellales, Agaricomycetidae, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* is in agreement in Species Fungorum, MycoBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Type species: *Corallofungus hatakeyamanus* Kobayasi

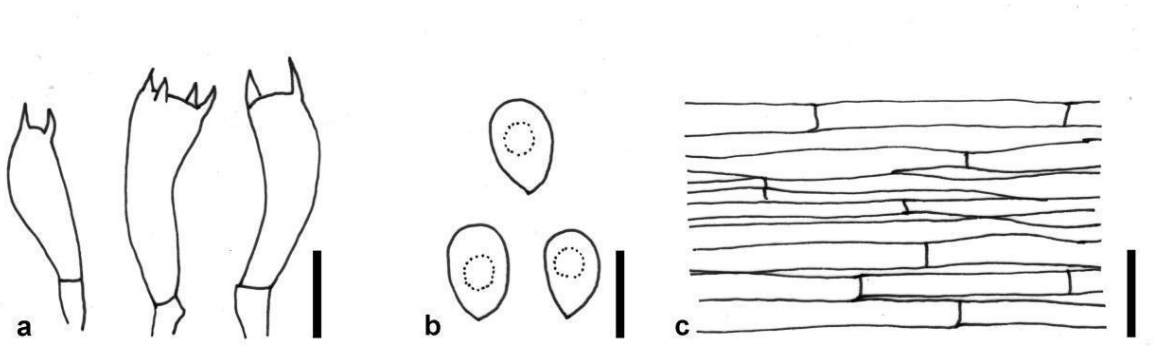


Fig. 177 – ***Corallofungus hatakeyamanus***. a Basidia. b Basidiospores. c Trama. Scale bar: a–c = 10 μm. Redrawn from Kobayashi (1983). For original basidiomata, refer to Kobayashi (1983).

Gloeomucro R.H. Petersen, Mycologia 72(2), 303

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 178

Classification: *Hydnaceae, Cantharellales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Gloeomucro is an ageotropic genus, characterised by its mucous to watery-gelatinous, lanceolate basidiomata and is classified within *Hydnaceae* Chevall. Petersen (1980) established the

genus to accommodate several species previously assigned to *Myxomycidium* Massee and proposed that the name *Myxomycidium* be regarded as a synonym of the genus *Mucronella* Fr. He designated *G. nodosus* (Linder) R.H. Petersen as the type species of the genus, which was previously described as *Myxomycidium nodosum* Linder, based on specimens collected from decaying wood in Tennessee, USA (Petersen 1980). *Gloeomucro* was traditionally placed within the family *Hydnaceae*, alongside other genera such as *Corallofungus* Kobayasi, *Ingoldiella* D.E. Shaw, *Parastereopsis* Corner, and *Repetobasidiellum* J. Erikss. & Hjortstam (He et al. 2019). However, all of these genera lack a contemporary phylogenetic assessment, and no molecular sequence data are available to validate their taxonomic placement (Cao et al. 2021). The classification of *Gloeomucro* in *Hydnaceae, Cantharellales, Agaricomycetidae, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* is in agreement in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Members of the genus *Gloeomucro* exhibit a mucronelloid morphotype, forming numerous small, ageotropic, clavarioid, unbranched, and club-shaped basidiomata that are distinctly hygrophanous to subgelatinous. Basidiospores are ellipsoid, smooth, thin-walled, inamyloid, indextrinoid, and acyanophilous (Bondartseva & Zmitrovich 2023). Basidia are clavate with 2- or 4-spored (Bondartseva & Zmitrovich 2023). The hyphal system is monomitic, with clamped generative hyphae, and cystidia are absent. *Gloeomucro* comprises 10 species worldwide (Hyde et al. 2024a). The species within this genus are often found growing on logs or other plant debris, commonly associated with forests and grasslands, often growing on acidic and humus-rich soils (Bondartseva & Zmitrovich 2023).

Type species: *Gloeomucro nodosus* (Linder) R.H. Petersen

Basionym: *Myxomycidium nodosum* Linder

Other accepted species:

G. asahimontanus (Kobayasi) R.H. Petersen
G. chlorinus R.H. Petersen
G. dependens (Berk. & M.A. Curtis) P. Roberts
G. flavus (G.W. Martin) R.H. Petersen
G. guianensis (Linder) R.H. Petersen
G. limpidus (R. Heim) R.H. Petersen
G. luteodiscus R.H. Petersen
G. ventricosus R.H. Petersen
G. yakusimensis (Kobayasi) R.H. Petersen

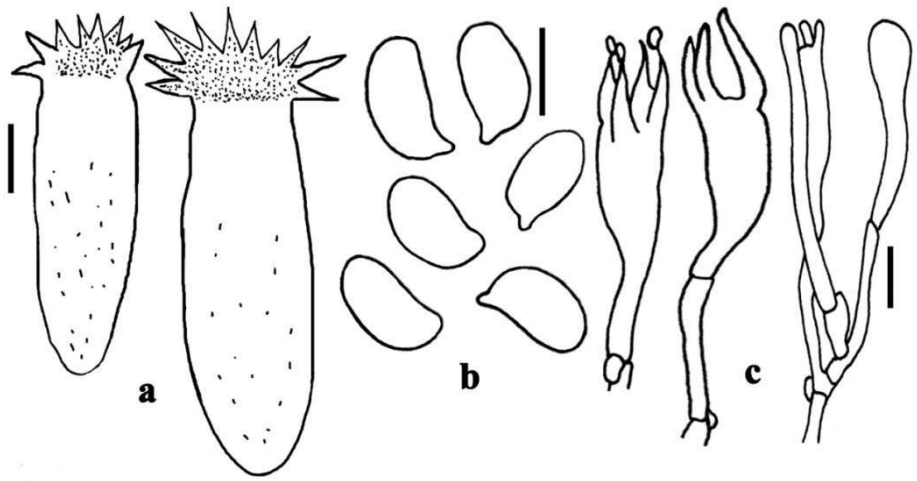


Fig. 178 – ***Gloeomucro nodosus***. a Basidiomata. b Basidiospores. c Basidia with elongated sterigmata and nodose-septate hyphae. Scale bars: a = 10 mm, b–c = 10 µm. Redrawn from Linder (1934).

Membranomyces Jülich, Persoonia 8(3), 296

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 179

Classification: *Hydnaceae, Cantharellales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Membranomyces was established in 1975 within *Clavulinaceae* Donk, but the current phylogenetic position of the genus has not been fully resolved (Jülich 1975, Uehling et al. 2012b). Jülich erected the genus with the type species *M. spurius* (Bourd.) Jülich, which was originally described as *Corticium spurium* Bourdot (Jülich 1975). The distribution of the species has been well investigated with the original reports from eastern Canada and Europe (Kotiranta & Saarenoksa 1993, Bernicchia & Gorjón 2010). However, a more recent investigation shows a much wider distribution, spanning much of the Northern Hemisphere, including Andorra, Belarus, eastern Canada, Denmark, Finland, France, Germany, Italy, Iran, Japan, Norway, Russia, Spain, Switzerland, Turkey, the UK, and the USA (Uehling et al. 2012b). Species of the genus are usually found scattered on wood of coniferous and frondose trees, also in leaf litter (Jülich 1975). They were considered saprotrophic until Tedersoo et al. (2003) detected *Membranomyces delectabilis* (H.S. Jacks.) Kotir. & Saaren. on ectomycorrhizal roots of *Populus* and *Picea*. A recent study also indicates that the genus is a common ectomycorrhizal symbiont of *Abies religiosa* Argüelles-Moyao et al. (2017). The classification of *Membranomyces* in *Hydnaceae, Cantharellales, Agaricomycetidae, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* is in agreement in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

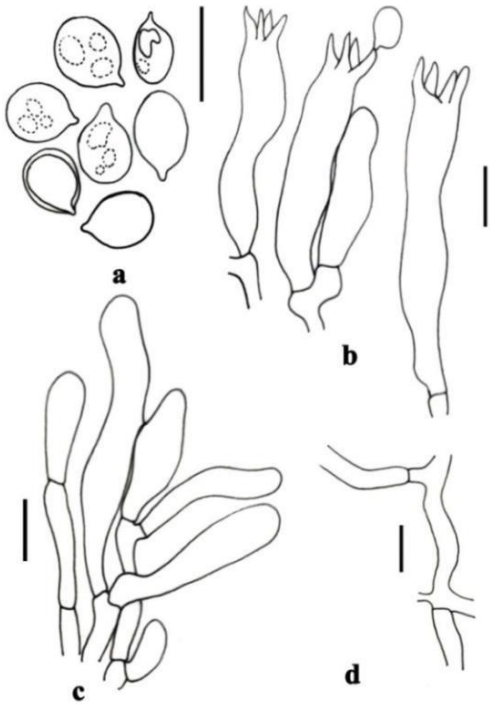


Fig. 179 – ***Membranomyces spurius*** (H. Bourdot 29742, holotype). a Basidiospores. b Basidia. c Basidioles. d Monomitic hyphae showing absence of clamp connections. Scale bars: a–d = 10 µm. Redrawn from Jülich (1975). For original basidiomata, refer to Uehling et al (2012b).

Membranomyces was erected to accommodate resupinate (crust-like), effused, adnate, membranous to subceraceous basidiomata with a smooth, cream to lemon yellow hymenophore lacking rhizomorphs (Jülich 1975, Uehling et al. 2012b). The monomitic hyphal system is hyaline to slightly yellowish and thin to slightly thick-walled, lacking clamp connections. It lacks cystidia and gloeocystidia. The genus has characteristic flexuous-cylindrical basidia with curved sterigmata,

broadly ellipsoidal, inamyloid, and smooth-walled basidiospores with numerous small guttules (Jülich 1975). Some authorities have recognised a second species, *M. delectabilis* (*Corticium delectabile* H.S. Jacks.); however, updated reports confirm the genus to be monotypic (Kotiranta & Saarenoksa 1993, Hyde et al. 2024a). A phylogenetic analysis by Tedersoo et al. (2003) using ITS sequences revealed that the exact phylogenetic relationship of the species is unclear, whereas Uehling et al. (2012b) found *M. delectabilis* nested within *Clavulina* J. Schröt. *M. delectabilis,* which was reported to differ from *M. spurius* in basidiospore length and the absence of cystidioid hymenial hyphae (Kotiranta & Saarenoksa 1993), was reclassified in 1973 as *Clavulicium delectabile* (H.S. Jacks.) Hjortstam.

Type species: *Membranomyces spurius* (Bourdot) Jülich

Basionym: *Corticium spurium* Bourdot

Multiclavula R.H. Petersen, American Midland Naturalist 77, 207

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 180

Classification: *Hydnaceae, Cantharellales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Multiclavula was accurately identified by R.H. Petersen (1967) for clavarioid fungi often associated with algae or bryophytes (Masumoto & Degawa 2020). It is characterised as simple or branched and small basidiomata (Petersen 1967, Masumoto & Degawa 2020). *Multiclavula* species are separated from *Lepidostromatales* by the number of sterigmata. *Multiclavula* species have (2–) 4–6 sterigmata per basidium, while *Lepidostromatales* have four (Masumoto & Degawa 2020).

The lichenized species form globular or bulbil-like thalli (e.g., *Botrydina*-type) where mycobiont hyphae surround green algal photobiont cells (Masumoto & Degawa 2020). The hyphal system is monomitic with clamp connections. Basidiospores are smooth, hyaline, thin-walled, non-amyloid, and aguttulate.

Multiclavula petricola is ecologically unique, being exclusively saxicolous (growing on wet volcanic rocks) (Masumoto & Degawa 2020). Its basidiospores are elongated to slightly cylindrical. Within *Multiclavula,* Species Fungorum (2026) recognised 14 species worldwide. Molecular phylogenetic analyses of ITS and LSU sequences confirm *Multiclavula* as a well-supported monophyletic group within *Cantharellales*.

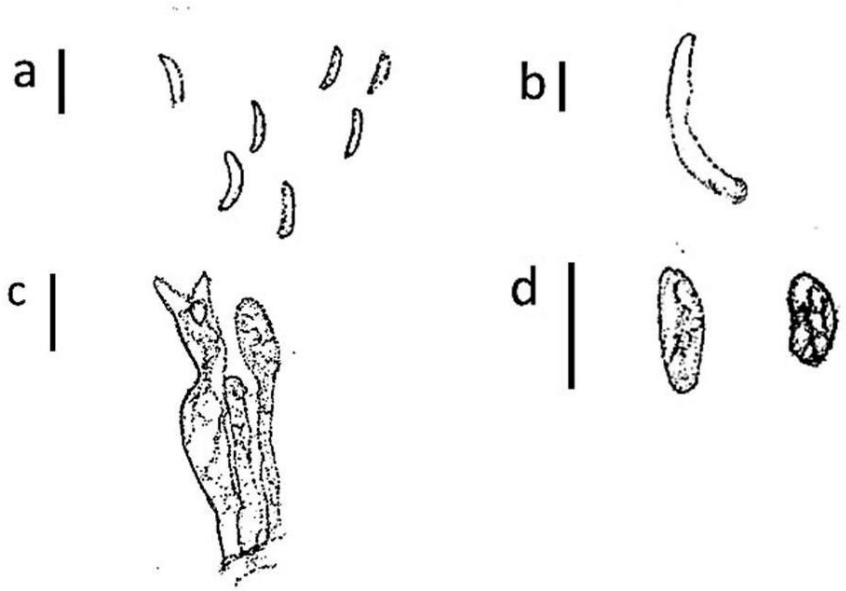


Fig. 180 – ***Multiclavula petricola*** (GMNHJ-FF1008198, holotype). a Basidiomata dispersed on the rock surface. b Basidioma. c Basidium. d Basidiospores. Scale bars: a = 5 mm, b = 1 mm, c–d = 10 µm. Redrawn from Masumoto & Degawa (2020). For original basidiomata, refer to Masumoto & Degawa (2020).

Multiclavula species have a global distribution. *M. mucida* is reported from temperate regions like Japan (Masumoto & Degawa 2020) and Romania (Papp et al. 2020) on rotten wood. *Multiclavula vernalis* is also known from Japan. *M. ichthyiformis* is reported from tropical Costa Rica (Nelsen et al. 2007, Masumoto & Degawa 2020). *M. petricola* is known only from its type locality in Gunma Prefecture, Japan (Masumoto & Degawa 2020). Some species are considered rare due to their specialised habitats (Papp et al. 2020). The classification of *Multiclavula* in *Hydnaceae, Cantharellales, Agaricomycetidae, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* is in agreement in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Type species: *Multiclavula corynoides* (Peck) R.H. Petersen

Basionym: *Clavaria corynoides* Peck

Other accepted species: (Species Fungorum – search *Multiclavula*)

Paullicorticium J. Eriksson., Symbolae Botanicae Upsalienses 16(no. 1), 66

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 181

Classification: *Hydnaceae, Cantharellales, Agaricomycetes, Agaricomycotina, Basidiomycota*, *Fungi*

Paullicorticium was established by J. Eriksson in 1958, with *P. pearsonii* as the type species (Eriksson 1958). In the same work, Eriksson also described an additional species, *P. allantosporum* (Liberta 1962). The genus comprises seven species, which are primarily distributed across North America, Europe, and Asia (India) (Kirk et al. 2008). The genus is believed to be saprotrophic, with most species found on decaying wood (Liberta 1962, Prasher 2015). The classification of *Paullicorticium* in *Hydnaceae, Cantharellales, Agaricomycetidae, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* is in agreement in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Paullicorticium species are characterised by their basidia, which may develop terminally, forming in heads, or remain sessile on prostrate hyphae (Liberta 1962). Their fructifications are resupinate, closely adnate, small, and very thin, often nearly invisible (Prasher 2015). They initially form as a scattered pruinate reticulum over the substratum, beginning as a hyphal network that intertwines into a thin layer. When fresh, the fruitification is ceraceous and fragile, but upon drying, it becomes pruinose-porulose under a lens. The basidiospores are hyaline, thin-walled, allantoid, ellipsoid, or navicular, non-amyloid, and non-cyanophilous. The basidia are obovate, obpyriform, or obconic, and typically feature a basal septum, bearing four to eight sterigmata (Liberta 1962, Prasher 2015). The hyphae are thin-walled and either with or without clamp connections (Prasher 2015).

Among corticiaceous genera, *Sistotrema* Fr., *Sistotremella* Hjortstam, *Botryobasidium* Donk, *Sistotremastrum* J. Erikss., and *Paullicorticium* share several common characteristics, including resupinate basidiomata, non-poroid hymenophores, the absence of asterohyphidia, setae, and dextrinoid hyphae, as well as IKI-basidiospores and basidia with 4–8 sterigmata (Gorjon 2020). *Paullicorticium* differs from other genera by its thin, barely visible basidiomata and obconical to pyriform basidia (Gorjon 2020). In contrast, *Sistotremastrum* exhibits distinct basidiomata with cylindric to clavate basidia (Gorjon 2020). *Paullicorticium* resembles *Amauromyces* in its thin basidiomata, monomitic hyphal system, short basidia, and absence of cystidial cells, but lacks cell-wall thickening in the basidia, and it produces more than four sterigmata (Chen & Oberwinkler 2004). Additionally, *Paullicorticium* features continuous parenthesomes in dolipores, distinguishing it from *Amauromyces* Jülich (Chen & Oberwinkler 2004). The ITS and LSU gene regions have been used for the classification of *P. ansatum* (Larsson et al. 2004).

Type species: *Paullicorticium pearsonii* (Bourdot) J. Erikss

Basionym: *Corticium pearsonii* Bourdot

Other accepted species:

P. allantosporum J. Erikss.

P. ansatum Liberta

P. crassiusculum Hjortstam
P. delicatissimum (H.S. Jacks.) Liberta
P. globosum Oberw.
P. indicum Dhingra

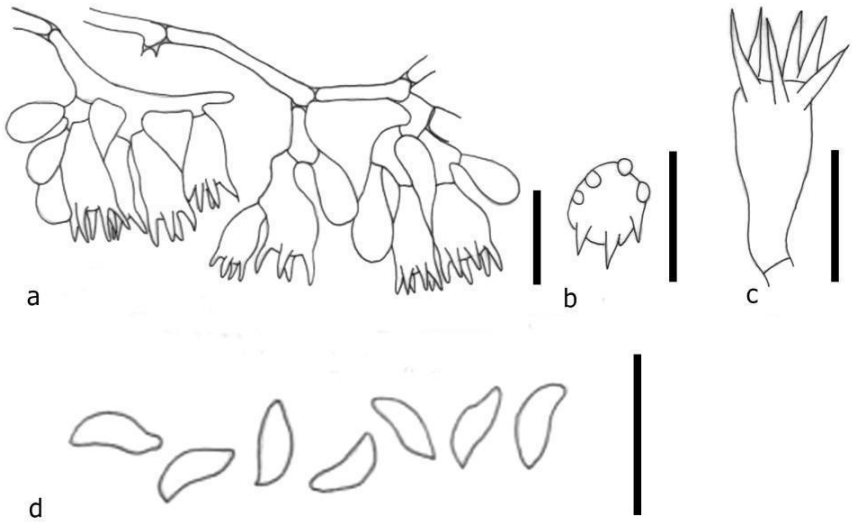


Fig. 181 – ***Paullicorticium pearsonii***. a Subhymenial and hymenial section. b Top view of basidium. c Basidia. d Basidiospores. Scale bars: a–d = 10 µm. Redrawn from a–c = Liberta (1962), d = Martini (2024). For original basidiomata, refer to University of Oslo (2025).

Repetobasidiellum J. Erikss. & Hjortstam, in Eriksson, Hjortstam & Ryvarden, *Corticiaceae* of North Europe 6, 1247

Species Fungorum, Facesoffungi, MycoBank Fig. 182

Classification: *Hydnaceae, Cantharellales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Repetobasidiellum was established by Eriksson & Hjortstam in 1981 to accommodate the monotypic *R. fusisporum*, which was designated as the type species (Eriksson et al. 1981). The type specimen was collected from dead rhachis of a fern in Sweden (Eriksson et al. 1981). *Repetobasidiellum fusisporum* has also been reported in the Netherlands, Europe (Veerkamp 2013).

The basidiomata of *Repetobasidiellum* are small, thin, orbicular, and closely adnate, appearing smooth and ceraceous when fresh, and crustaceous upon drying, with a pale greyish-brown colouration (Eriksson et al. 1981). The hyphal system is monomitic with highly branched hyphae. The dendrohyphidia are thin-walled, sparsely branched, and broad at the base. Basidia are initially subglobose and later urn-shaped, occurring in short intervals, with older basidia forming a dense sheath around their bases. The basidiospores are sublunate to subfusiform, smooth, thin-walled, containing one or more oil-drops, inamyloid and non-cyanophilous (Eriksson et al. 1981).

Identification of the *Repetobasidiellum* relies exclusively on morphological characteristics due to the absence of molecular evidence (He et al. 2019). While *Repetobasidiellum* resembles *Repetobasidium* J. Erikss. in basidia arrangement, it differs by having urniform-shaped basidia, whereas those in *Repetobasidium* are ovate (Eriksson et al. 1981). Furthermore, *Repetobasidiellum* has sterile, branched hyphae in the hymenium, known as dendrohyphidia, which are absent in *Repetobasidium*. The classification of *Repetobasidiellum* in Species Fungorum, UNITE, and Hyde et al. (2024a) is under *Hydnaceae*, whereas MycoBank lists it under *Rickenellaceae* and may need updating.

Type species: *Repetobasidiellum fusisporum* J. Erikss. & Hjortstam

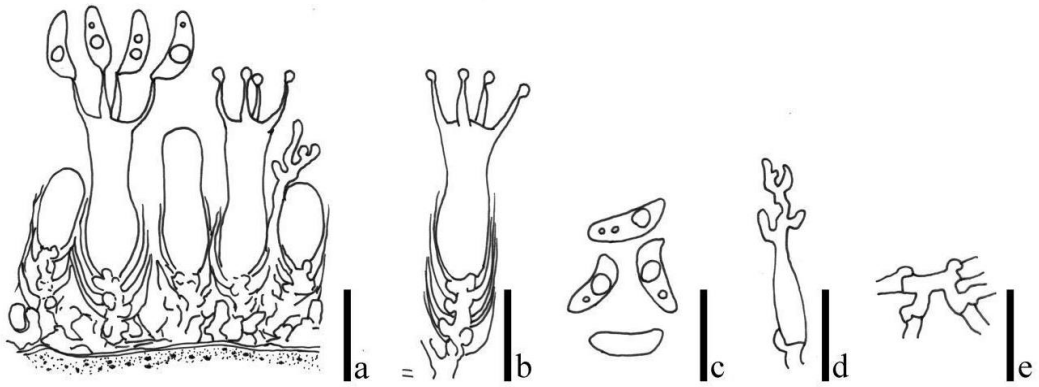


Fig. 182 – ***Repetobasidiellum fusisporum*** (Hallingback 24884, holotype). a A section through basidiomata. b Basidia. c Basidiospores. d Dendrohyphidia. e Branching hyphae. Scale bar: a–e = 10 µm. Redrawn from Eriksson et al. (1981).

Rogersiomyces J.L. Crane & Schokn., American Journal of Botany 65, 903

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 183

Classification: *Hydnaceae, Cantharellales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Rogersiomyces was established by J.L. Crane and J.D. Schoknecht to accommodate a single species, *R. okefenokeensis*, as the type species (Crane & Schoknecht 1978). The specimen was collected from submerged decayed leaves of angiosperms and *Taxodium ascendens* Brongn. in the Okefenokee Swamp National Wildlife Refuge, Georgia, USA (Crane & Schoknecht 1978). Initially, *Rogersiomyces* was classified under *Filobasidiaceae* L.S. Olive due to the presence of an apobasidium with elongated metabasidial sprouts (Crane & Schoknecht 1978, Psurtseva et al. 2016). Another new species, *R. malaysianus*, which was collected from Vietnam, was previously classified as *Hyphobasidiofera malaysiana* K. Matsush. & Matsush. (Psurtseva et al. 2016). It has since been reclassified under *Hydnaceae* (Psurtseva et al. 2016). The specimen was collected from the bark of a broadleaf tree and was described as a new species and genus (Matsushima 1996, Psurtseva et al. 2016). Phylogenetic analyses using ITS, LSU, and SSU loci, along with morphological characteristics, were conducted to identify *R. malaysianus* (Psurtseva et al. 2016). Only two species of *Rogersiomyces* are recognised (He et al. 2019, Hyde et al. 2024a).

Basidiomata of *Rogersiomyces* consist of fasciculate, loose, aseptate apobasidia and basidiospores germinating directly into hyphae. The presence of apobasidia is thought to be an adaptation to aquatic habitats (Crane & Schoknecht 1978, Kirschner & Chen 2003). The basidia are obclavate with prominent, truncate sterigmata. The basidiospores are symmetrically borne, non-apiculate, and germinate directly into hyphae (Crane & Schoknecht 1978).

Kirschner and Chen (2003) collected *R. kenfenokeensis* from insect tunnels in pine bark, revealing additional morphological characteristics, including septal pores observed using a scanning electron microscope. This perforated parenthesomata provided a basis for positioning *Rogersiomyces* within *Holobasidiomycetes* (Psurtseva et al. 2016). Psurtseva et al. (2016) also presented molecular evidence, culture morphology, lifecycle karyology, and mating experiments for *R. malaysianus*. Molecular studies indicated a close relationship between *Rogersiomyces* and *Sistotrema sensu lato* and *Hydnum sensu stricto*. However, the precise taxonomic position of the genus remains unclear, indicating the need for further research (Psurtseva et al. 2016). The classification of *Rogersiomyces* in Species Fungorum, MycoBank, UNITE, and Hyde et al. (2024a) is under *Hydnaceae*, whereas GenBank lists it under *incertae sedis* and may need updating.

Synonymy: *Hyphobasidiofera* K. Matsush. & Matsush.

Type species: *Rogersiomyces okefenokeensis* J.L. Crane & Schokn.

Other accepted species: *R. malaysianus* (K. Matsush. & Matsush.) Zmitr.

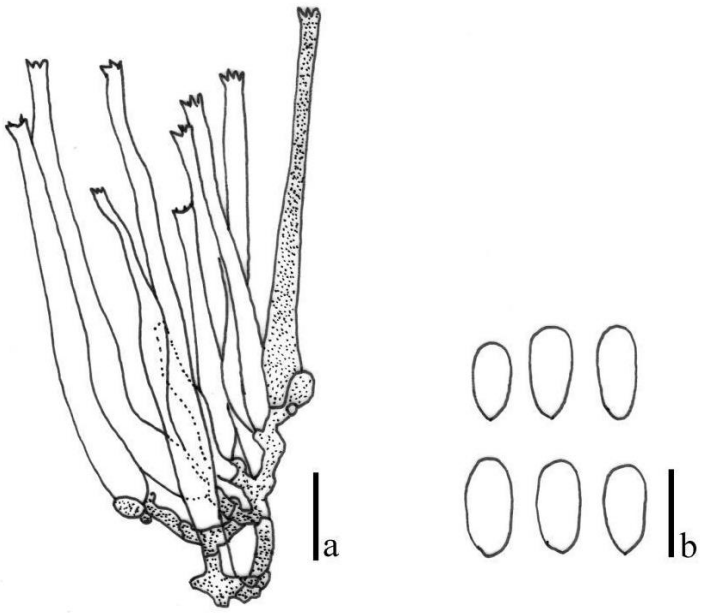


Fig. 183 – ***Rogersiomyces okefenokeensis*** (R. Kirschner 532). a Cluster of basidia, presence of cytoplasm indicated with dots, empty in some cases, and collapsed basidia without dots. b Basidiospores. Scale bar: a–b = 10 µm. Redrawn from Kirschner & Chen (2003).

Scotomyces Jülich, Persoonia 10(1), 139

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 184

Classification: *Hydnaceae, Cantharellales, Agaricomycetes, Agaricomycotina, Basidiomycota*, *Fungi*

Scotomyces, a monotypic genus, was established by Jülich in 1978 based on the description of *Corticium fallax* G. Cunn. (Jülich 1978). This specimen, described as the type species, was collected on *Beilschmiedia tawa* in New Zealand (Jülich 1978). *Scotomyces subviolaceus* is saprophytic, found under decaying tree trunks (Gungor et al. 2013). According to Species Fungorum (2025), there are two species of *Scotomyces,* although He et al. (2019) and Hyde et al. (2024a) recognised only one. *Scotomyces subviolaceus* is listed as rare in the draft European Red List (Ambrosio 2014). The classification of *Scotomyces* in Hyde et al. (2024a) is under *Hydnaceae*, whereas Species Fungorum, MycoBank, GenBank, and UNITE list it under *Ceratobasidiaceae* and may need updating.

The basidiomata of *Scotomyces* are annual, resupinate, effused, and more or less adnate, exhibiting a powdery, soft-membranaceous texture and an indistinct margin. They lack rhizomorphs or hyphal strands (Jülich 1978, Gungor et al. 2013, Zíbarová & Holec 2021). Their colour ranges from greyish olive to dark grey-violet, lighter than fresh specimens. They are non-cracking and non-detachable (Gungor et al. 2013, Zíbarová & Holec 2021). The hymenial surface is smooth, featuring vertically branched hyphae (Jülich 1978, Gungor et al. 2013).

Microscopically, the hyphal system is monomitic, consisting of hyaline, thin-walled, cylindrical, clamped, and non-agglutinated hyphae (Jülich 1978, Gungor et al. 2013). Cystidia are absent (Jülich 1978). The basidia are hyaline, thin-walled, cylindrical to narrowly clavate, and possess four long sterigmata (Jülich 1978, Ellis & Ellis 1990). The basidiospores are smooth, varying from hyaline to light brown to dark brown, thin-walled, more or less ellipsoid, and guttulate, inamyloid, and non-cyanophilic (Jülich 1978, Gungor et al. 2013).

Synonymy: *Hydrabasidium* Park.-Rhodes

Type species: *Scotomyces subviolaceus* (Peck) Jülich

Basionym: *Hypochnus subviolaceus* Peck

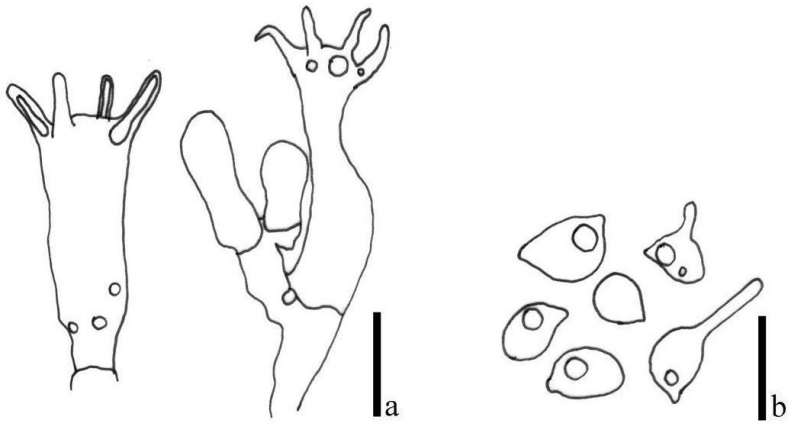


Fig. 184 – ***Scotomyces subviolaceus*** (HR B010800). a Basidia. b Basidiospores. Scale bar: a–b = 10 µm. Redrawn from Zíbarová & Holec (2021). For original basidiomata, refer to Zíbarová & Holec (2021).

Sistotremella Hjortstam, in Eriksson, Hjortstam & Ryvarden, Corticiaceae of North Europe 7, 1379

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 185

Classification: *Hydnaceae, Cantharellales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Sistotremella was initially established under *Corticiaceae* Herter in 1984 with its type species *S. perpusilla* Hjortstam (Eriksson et al. 1984). However, presently it is described in *Hydnaceae* Chevall. (He et al. 2019). The classification of *Sistotremella* in *Hydnaceae, Cantharellales, Agaricomycetidae, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* is in agreement in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a). Currently, Species Fungorum (2026) lists three species of *Sistotremella*.

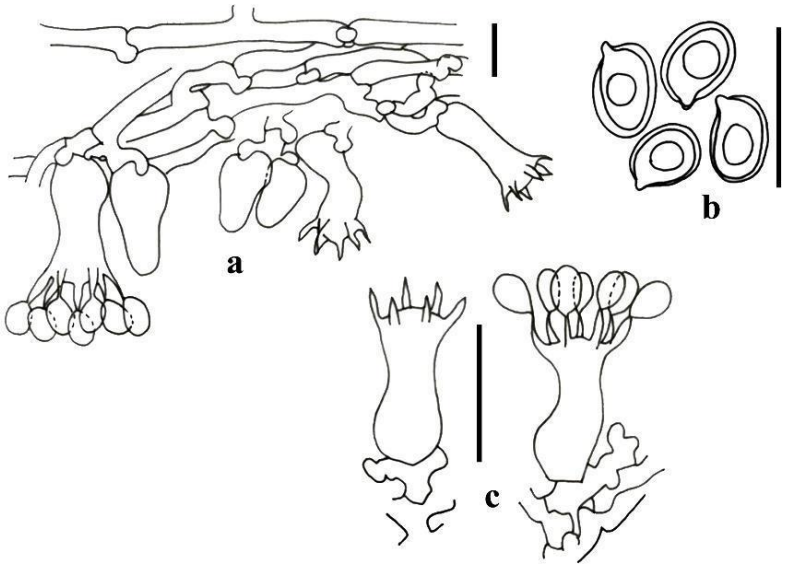


Fig. 185 – ***Sistotremella perpusilla*** (holotype). a Section of basidiomata. b Basidiospores. c Basidia. Scale bars: a–c = 10 µm. Redrawn from Eriksson et al. (1984). For original basidiomata, refer to GBIF (2011).

The genus is characterised by basidiomata resupinate, effused, smooth, closely adnate, and crustaceous when young and living, whereas on drying form pruina or a very thin layer of crust on

their respective substratum (Eriksson et al. 1984). Basidiospores are ellipsoidal, cyanophilous, smooth, thick-walled. Basidia are urniform, with 6–8 sterigmata. Cystidia are either absent or present in the form of gleocystidia. The hyphal system is monomitic, with or without clamp-connections. Sub-hymenium is composed of straight hyphae at the base (Eriksson et al. 1984). The members belonging to *Sistotremella* were found growing on rotten wood in both coniferous and deciduous forests. The genus is distributed in Denmark, France, Germany, Norway, and Sweden (Eriksson et al. 1984, He et al. 2019). Molecular studies conducted in this group are rare, primarily based on ITS and LSU markers. Phylogenetically, *Sistotremella* is closely related to *Neoburgoa* Diederich E. Zimm. & Lawrey, but the latter is differentiated as a lichenicolous fungus forming bulbils similar to basidiomata on their substratum (Cao et al. 2021). *Sistotremella* is also closely related to *Sistotrema* Fr., but differs in having thick-walled and cyanophilous basidiospores and the absence of oil-rich contents in hyphae (Eriksson et al. 1984).Type species: *Sistotremella perpusilla* Hjortstam

Other accepted species:

S. hauerslevii Hjortstam

S. paullicorticioides Boidin & Gilles

Cantharellales genera incertae sedis

Ceratoporia Ryvarden & de Meijer, Synopsis Fungorum (Oslo) 15, 44

Species Fungorum, Facesoffungi, MycoBank Fig. 186

Classification: *Incertae sedis, Cantharellales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Ceratoporia, a monotypic taxon, was established by Leif Ryvarden & André A.R. de Meijer in 2002 (Ryvarden & de Meijer 2002). The type species *C. perplexa* was described in a sample collected from a decayed dicotyledonous branch in Paraná, Brazil. *Ceratoporia* is found in neotropical regions and exhibits a saprobic habit (Ryvarden & de Meijer 2002). The classification of *Ceratoporia* in Hyde et al. (2024a) is under *incertae sedis*, whereas Species Fungorum, MycoBank and UNITE list it under *Ceratobasidiaceae* and may need updating. Basidiomata of *Ceratoporia* are annual, resupinate, with white to cream pore surfaces, thin-walled, and round to angular pores (Ryvarden & de Meijer 2002). The hyphal system is monomitic and consists of generative hyphae with clamps that are strongly twisted, especially close to the clamps. Basidia are clavate, featuring a clamp at the base and large cylindrical sterigmata. Basidiospores are cylindrical, smooth, thin-walled, and do not react with Melzer's reagent. Dendrohyphidia are present in the hymenium, whereas cystidia, when present, are thin-walled and pointed (Ryvarden & de Meijer 2002).

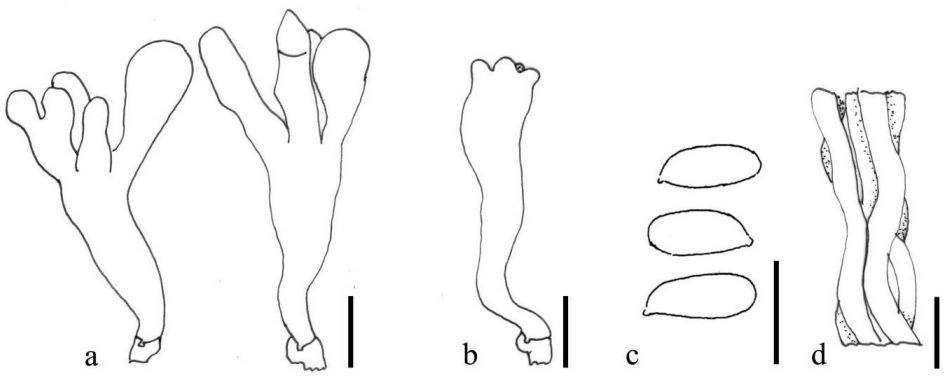


Fig. 186 – ***Ceratoporia perplexa*** (holotype). a Basidia. b Immature basidia. c Basidiospores. d Hyphae from subiculum. Scale bar: a–d = 10 µm. Photo credit: Redrawn from Ryvarden & de Meijer (2002).

The identification of *Ceratoporia* species is based solely on morphological characteristics, as no molecular evidence has been reported (He et al. 2019). *Ceratoporia* is recognised as the first poroid genus within *Ceratobasidiales*, which is typically characterised by resupinate, smooth, and corticoid genera (Ryvarden & de Meijer 2002). Ceratobasidiales includes species featuring basidia with large tubular sterigmata and strongly twisted hyphae, which distinguishes it from the *Polyporaceae* (Ryvarden & de Meijer 2002).

Type species: *Ceratoporia perplexa* Ryvarden & de Meijer

Corticiales K.H. Larss., Hibbett et al., Mycological Research 111(5), 540

Species Fungorum, Facesoffungi, MycoBank, GenBank

Corticiaceae Herter, Kryptogamenflora der Mark Brandenburg und Angrenzender Gebiete (Leipzig) 6(1), 70

Species Fungorum, Facesoffungi, MycoBank, GenBank

Classification: *Corticiales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Corticiaceae is a family of corticioid or crust-forming fungal species established by W.G.F. Herter (1910), with *Corticium* Pers. as the type genus (Herter 1910, Ghobad-Nejhad et al. 2021). The family consists of 14 genera: *Basidiodesertica* Maharachch., Wanas. & Al-Sadi, *Capillosclerotium* Prameela & Deeba, *Corticium*, *Disporotrichum* Stalpers, *Erythricium* J. Erikss. & Hjortstam, *Galzinia* Bourdot, *Giulia* Tassi, *Laetisaria* Burds., *Lawreymyces* Lücking & Moncada, *Marchandiomyces* Diederich & D. Hawksw., *Mycobernardia* Ghobad-Nejhad, *Necator* Massee, *Tretopileus* B.O. Dodge, and *Waitea* Warcup & P.H.B. Talbot (Hyde et al. 2024a). Members of *Corticiaceae* are distributed worldwide and exhibit diverse nutritional modes, including saprophytic, plant pathogenic, lichenicolous, and endolichenic (He et al. 2024).

Erythricium J. Erikss. & Hjortstam, Svensk Botanisk Tidskrift 64(2), 165

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 187

Classification: *Corticiaceae, Corticiales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Erythricium was established by Eriksson & Hjortstam (1970) for pinkish resupinate fungi with large cyanophilous basidiospores. Molecular studies confirmed its placement in *Corticiales*, grouping with *Laetisaria* Burds and *Marchandiobasidium* Diederich & Schultheis (Lawrey et al. 2007, 2008). Within *Erythricium,* Species Fungorum (2026) recognised 6 species worldwide. Members of *Erythricium* exhibit diverse ecological strategies. Saprotrophic taxa like *E. laetum* and *E. atropatanum* colonise dead wood or herbaceous debris in temperate to subtropical forests (Eriksson & Hjortstam 1970, Ghobad-Nejhad & Hallenberg 2011). *E. salmonicolor* is a notorious plant pathogen, causing pink disease in tropical crops such as citrus and rubber trees (Burdsall & Cramer 1985). Lichenicolous species such as *E. aurantiacum* parasitise *Physcia* and *Xanthoria* lichens, forming bulbils that invade thalli. Host specificity of *E. aurantiacum* targets *Physcia adscendens* and *P. tenella* (Diederich et al. 2022). Distribution ranges from Holarctic (*E. laetum*) to tropics (*E. salmonicolor*), while *E. atropatanum* is currently known only from Iran (Ghobad-Nejhad & Hallenberg 2011).

The basidiomata of *Erythricium* are typically thin, ceraceous, and closely adnate to the substrate (Ghobad-Nejhad & Hallenberg 2011). Hyphal systems are monomitic, simple-septate hyphae lacking clamp connections. Basidia are clavate to suburiform. Basidiospores are distinctive, hyaline, smooth, and cyanophilous, with pyriform to broadly ellipsoid shapes and prominent apiculi (Diederich et al. 2022).

Tan & Bishop-Hurley (2025) found that *Erythricium ludbrookiae* Y.P. Tan & Bishop-Hurley is different from *E. atropatanum* by comparing ITS and LSU sequences. Molecular evidence demonstrates that *Erythricium* and *Marchandiobasidium* are congeneric, with phylogenetic analyses placing them in the same well-supported clade, alongside the type species *Erythricium laetum* (Lawrey et al. 2007, Ghobad-Nejhad et al. 2011). This relationship led to the formal transfer

of *Marchandiobasidium aurantiacum* to *Erythricium* as *E. aurantiacum* (Hawksworth & Henrici 2015). The clade unites taxa with divergent ecologies, such as *E. laetum,* a lignicolous saprotroph and *E. aurantiacum,* which is lichenicolous parasitising *Physcia* spp. (Diederich et al. 2003). The classification of *Erythricium* in *Corticiaceae, Corticiales, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* agrees in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Synonyms: *Marchandiobasidium* Diederich & Schultheis

Type species: *Erythricium laetum* (P. Karst.) J. Erikss. & Hjortstam

Basionym: *Hyphoderma laetum* P. Karst.

Other accepted species:

E. atropatanum Ghob.-Nejh. & Hallenb.

E. aurantiacum (Lasch) D. Hawksw. & A. Henrici

E. hypnophilum (P. Karst.) J. Erikss. & Hjortstam

E. laetum (P. Karst.) J. Erikss. & Hjortstam

E. ludbrookiae Y.P. Tan & Bishop-Hurley

E. vernum Ghob.–Nejh., Nakasone & Ginns

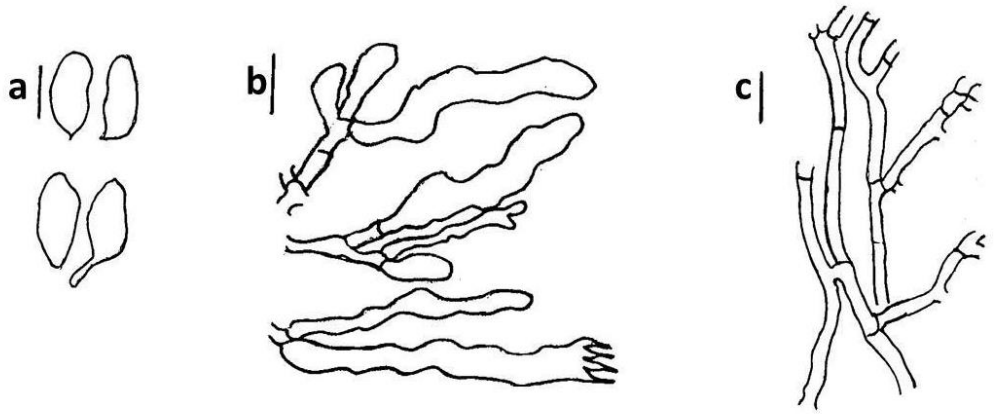


Fig. 187 – ***Erythricium atropatanum*** (holotype). a Basidiospores. b Basidia in different stages of development. c Basal hyphae. Scale bars: a–c = 10 µm. Redrawn from Ghobad-Nejhad & Hallenberg (2011). For original basidiomata, refer to Ghobad-Nejhad & Hallenberg (2011).

Laetisaria Burds., Transactions of the British Mycological Society 72(3), 420

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 188

Classification: *Corticiaceae, Corticiales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Laetisaria was originally proposed as a new genus by Burdsall Jr (1979) to accommodate *Hypochnus fuciformis* (Berk.) McAlpine of *Thelephoraceae* Chevall, which was not considered to be an appropriate disposition for McAlpine's species, leading to the proposal of a new genus. The genus is now placed in *Corticiaceae* Herter with *L. fuciformis* (Berk.) Burds. as the type species of the anamorph, which is *Isaria fuciformis* Berk. (Burdsall Jr 1979, Wijayawardene et al. 2022). The species of the genus are usually effused, corticoid in habit, and occur on turfgrass and living grasses (causing "red-thread" and pink-patch symptoms), mostly parasitic on leaves of monocotyledons, on dead wood and bark, in soil as saprotrophs, and even as lichenicolous fungi, while some are bulbil-forming. Different species show diverse nutritional modes (pathogenic, saprotrophic, lichenicolous) (Burdsall Jr 1979, Diederich et al 2018, Ghobad-Nejhad et al. 2021). The species occurs in temperate and tropical regions worldwide, including Asia, Australia, Europe, North America, South America, and the Netherlands (Burdsall Jr 1979, Ghobad-Nejhad et al. 2021). The classification of *Laetisaria* in *Corticiaceae, Corticiales, Agaricomycetes, Agaricomycotina*, and *Basidiomycota*

agrees in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Asexual stage in *Laetisaria*, when present, is clavarioid, cylindrical, auminate or clavate, occasionally branching, pink to coral coloured, having distinct irregularly scattered swellings (bulbils) in the contextual hyphae (Diederich et al. 2018). Teleomorph stage, when present, effused, as thin, pink when fresh to orange, gelatinous and brittle when dry, like an almost invisible layer, membranous to pellicular basidiomata (Burdsall Jr 1979). The hyphal system is monomitic, a thin layer of subiculum parallel to the substratum, with sometimes slightly thick-walled, smooth, long-celled, hyaline hyphae, with or without clamps, giving rise to hyphidia and probasidia. Probasidium is initially sphaeropedunculate, producing a cylindrical to clavate, four-sterigmate, thin-walled metabasidium at maturity. Cystidia not observed; Basidiospores ellipsoid to broadly ellipsoid, flattened adaxially, shorter than 20 µm with a large apiculus, thin-walled, not reacting in Melzer's reagent (Burdsall Jr 1979). Within *Laetisaria*, Species Fungorum (2026) lists eleven species worldwide.

A phylogenetic analysis of ITS and LSU sequences indicates the current position of the monophyletic genus *Laetisaria* and *Marchandiomyces* Diederich & D. Hawksw. requires revision, and *Limonomyces* Stalpers & Loer. should be regarded as a synonym of *Laetisaria* (Diederich et al. 2018). An evolutionary study speculating the nutritional modes in family *Corticiaceae* using LSU+ITS+SSU+SSU analysis indicated that the *Laetisaria* clade likely originated as saprotrophic, shifted to parasitism, and later regained saprotrophy in wood-inhabiting species (Ghobad-Nejhad et al. 2021). Based on observations, a new combination of *Corticium endoxylon* Duhem & H. Michel was proposed as all four isolates of *Corticium endoxylon,* including its type, clustered in the *Laetisaria* clade (Ghobad-Nejhad et al. 2021). A new lichenicolous species, *L. macrospora,* has been described based on phylogenetic analysis (ITS) and morphological characteristics (Ertz et al. 2025).

Laetisaria is easily distinguished from its closely related genus *Laeticorticium* Donk by its broader hyphae, reduced hyphidia, and catahymenium, and it inhabits grasses rather than wood.

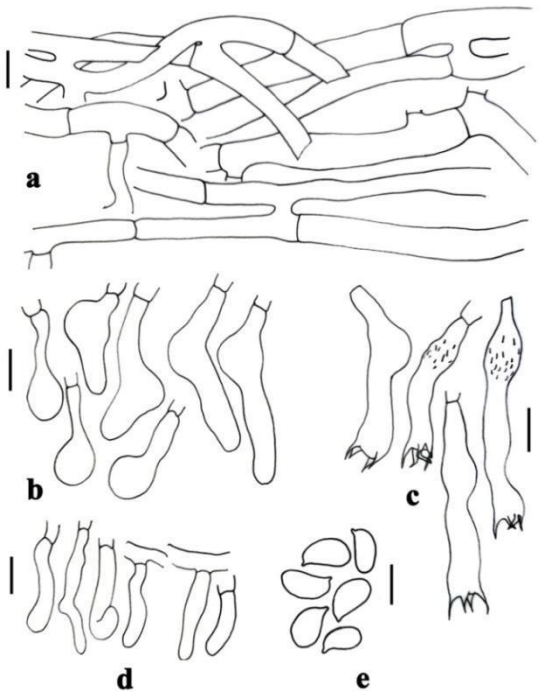


Fig. 188 – ***Laetisaria fuciformis*** (MEL 76716, holotype). a Hyphae of the subiculum. b Probasidia, some producing metabasidia. c mature basidia. d Dendrohyphidia. e Basidiospores. Scale bars:

a–e = 10 µm. Redrawn from Burdsall Jr (1979). For original basidiomata, refer to Ghobad-Nejhad et al (2021).

Type species: *Laetisaria fuciformis* (Berk.) Burds.
Basionym: *Isaria fuciformis* Berk.
Other accepted species: (Species Fungorum – search *Laetisaria*)

Marchandiomyces Diederich & D. Hawksw., in Diederich, Mycotaxon 37, 311
Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 189
Classification: *Corticiaceae, Corticiales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Marchandiomyces is a homobasidiomycete and lichenicolous genus, established based on the type species *M. corallinus* (Roberge) Diederich & D. Hawksw. (Diederich 1990). Most species within the genus are known only from their anamorphic states (Depriest et al. 2005). Key features include formation of delimited colonies with subspherical sclerotia, which subsequently differentiate into convex sporodochia composed of polyhedral to subspherical cells (Diederich 1990). The conidiophores are semi-macronematous, hyaline, thin-walled, and branched at the base, while the conidia are hyaline, obpyriform to obovoid, thick-walled, truncated at the base, and finely verrucose (Diederich 1990). Although initially nine species were described under *Marchandiomyces*, molecular analyses led to the inclusion of *M. quercinus* (Hawksworth & Henrici 2015) and the exclusion of *M. buckii* Diederich & Lawrey, *M. marsonii* Diederich & Lawrey, and *M. nothofagicola* Diederich & Lawrey, which were transferred to *Laetisaria*. *M. aurantiacus* (Lasch) Diederich & Etayo, colonising *Physcia* lichens, was linked to a ceratobasidiales-like teleomorph, *Marchandiobasidium aurantiacum* (Diederich et al. 2003), and later synonymised as *Erythricium aurantiacum* (Lasch) D. Hawksw. & A. Henrici (Hawksworth & Henrici 2015).Within *Marchandiomyces,* Species Fungorum (2026) recognise five species worldwide. All these species are supported with a taxonomic key (Diederich & Lawrey 2007, Ghobad-Nejhad et al. 2021).

Marchandiomyces corallinus is an obligate lichenicolous fungus, mainly on *Parmeliaceae* lichens like *Flavoparmelia baltimorensis* in the USA, and also occurs in many hosts (dominant host *Pertusaria*) from Europe (Molina et al. 2005, Diederich & Lawrey 2007). *Marchandiomyces allantosporus* was described on *Juniperus* and *Pinus halepensis* hosts collected from France (Ghobad-Nejhad et al. 2021), while *M. aurantioroseus* is reported from Europe and the USA (Diederich & Lawrey 2007). *M. lignicola*, with smaller sclerotia than *M. corallinus* and *M. aurantiacus*, was found on dead *Quercus* branches in the USA (Depriest et al. 2005). *Marchandiomyces quercinus*, formerly known as *Laeticorticium quercinum*, occurs on *Quercus* twigs and other hardwood branches, often associated with the ascomycete *Colpoma quercinum* and is widespread in Europe (Hawksworth & Henrici 2015).

Phylogenetic studies indicate that *Marchandiomyces* is polyphyletic, with *M. aurantiacus* more closely related to saprophytic and plant pathogenic *Erythricium* species like *E. laetum* and *E. salmonicolor*, rather than to other *Marchandiomyces* species (Diederich & Lawrey 2007). The genus is also closely related to *Omphalina foliacea* (Diederich & Lawrey 2007). The known distribution of *Marchandiomyces* is limited to Europe and North America, and further global exploration is needed, especially with the establishment of teleomorph linkage and additional protein-coding gene data, as current NCBI data are largely limited to ITS and ribosomal genes (LSU and SSU). The classification of *Marchandiomyces* in *Corticiaceae, Corticiales, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* agrees in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Synonyms: *Marchandiopsis* Ghob.-Nejh. & Hallen
Type species: *Marchandiomyces corallinus* (Roberge) Diederich & D. Hawksw
Basionym: *Illosporium corallinum* Roberge
Other accepted species:
M. allantosporus Ghob.-Nejh

M. aurantioroseus (P. Karst.) Ghob.-Nejh
M. lignicola Lawrey & Diederich
M. quercinus (J. Erikss. & Ryvarden) D. Hawksw. & A. Henrici

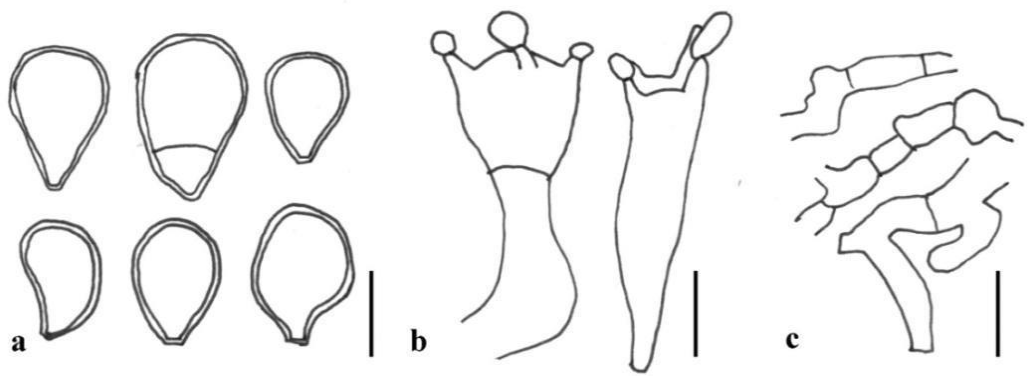


Fig. 189 – ***Marchandiobasidium aurantioroseus*** (holotype). a Basidiospores. b Basidia. c Contorted basal hyphae. Scale bars: a–c = 10 µm. Redrawn from Diederich et al. (2003). For original basidiomata, refer to Diederich et al. (2003).

Tretopileus B.O. Dodge, Bulletin of the Torrey Botanical Club 73, 223
Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 190
Classification: *Corticiaceae*, *Corticiales*, *Agaricomycetes*, *Agaricomycotina*, *Basidiomycota*, *Fungi*

Tretopileus was introduced by Dodge in 1946, designating *Tretopileus opuntia* Dodge as the type species, collected on *Opuntia ammophila* in Florida. *Tretopileus* species are largely distributed across pantropic regions, including Thailand and Indonesia (Munjal 1962, Seifert 1990, Okada et al. 1998). They are occasionally considered very weakly parasitic, not strongly parasitic on the plants, and primarily saprophytic, thriving on decaying plant material, with collections from tropical and subtropical regions (Dodge 1946, Munjal 1962, Okada et al. 1998). The classification of *Tretopileus* in *Corticiaceae, Corticiales, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* agrees in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a). Currently, Species Fungorum (2026) lists three species of *Tretopileus*.

Tretopileus species are mainly characterised by their basidiomata, which appear as articulated segments that are sometimes separable. The outer layer or bark consists of thick-walled brown hyphae, arranged longitudinally along the segment. The internal pith is thin, covered by similarly arranged cells. The pileus is concave-convex, with a dark brown, hard surface membrane. It is protected by fine pores or areolae, and its internal cells are arranged in radiating series, allowing easy detachment from the base (Dodge 1946).

The higher taxonomic rank of the genus remains ambiguous. Early speculation by Dodge suggested it might represent a sterile form of ascolichens (*Calicium* Pers.) or gasteromycetes (*Myriostoma* Desv. and *Calvatia* Fr.), while later classifications placed it in *Mycelia Sterilia* and Hyphomycetes (Berkeley & Curtis 1868, Munjal 1962, Subramanian 1971). However, research on *T. sphaerophorus* in Thailand revealed clamp connections of the vegetative and synnematous hyphae, typical of mitotic basidiomycetes, refining its placement in fungal taxonomy (Matsushima 1995, Okada et al. 1998).

Type species: *Tretopileus opuntiae* B.O. Dodge
Other accepted species:
T. indicus Munjal
T. sphaerophorus (Berk. & M.A. Curtis) S. Hughes & Deighton

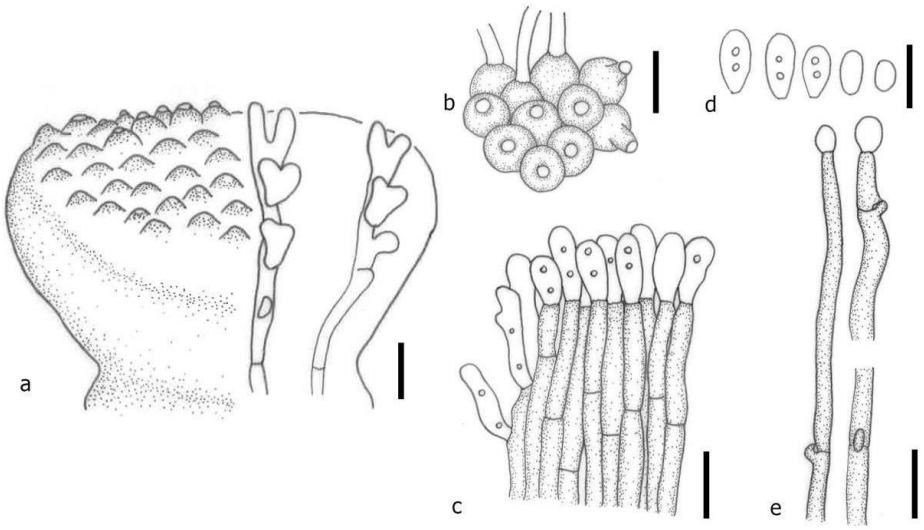


Fig. 190 – ***Tretopileus sphaerophorus***. a Bulbil attaching to the top of a synnema and the pigmented cuticular peridium-like structure with slightly projecting hyphae on the upper flat surface. b Germination of the projecting hyphae. c Hyphal regeneration from the cut-off end of a synnema. d Conidium-like separated tips from the regenerated top of the synnemata. e Regenerating hyphal tips of a synnema with clamp connections. Scale bars: a–e = 10 μm. Redrawn from Okada et al. (1998).

Waitea Warcup & P.H.B. Talbot, Transactions of the British Mycological Society 45(4), 503

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 191

Classification: *Corticiaceae*, *Corticiales*, *Agaricomycetes*, *Agaricomycotina*, *Basidiomycota*, *Fungi*

Waitea is a corticioid genus belonging to the family *Corticiaceae*, typified by *W. circinata* Warcup & P.H.B. Talbot (Warcup & Talbot 1962). This genus is a saprotroph or plant pathogen of legumes, cereals, and turf grasses (Hannan & Cushnahan, 2010, Chang & Lee 2016). *Waitea* is named after the Waite Agricultural Research Institute in Australia, where the genus was first studied (Warcup & Talbot 1962). Initially, the genus was monotypic with only the species *W. circinata*, but Gruhn & Ghobad-Nejhad (2020) discovered a new species, *W. guianensis* G. Gruhn & Ghobad-Nejhad, and added a new combination, *W. arvalis* (Burds.) Ghobad-Nejhad. At present, the genus includes three species (Gruhn & Ghobad-Nejhad, 2020). The classification of *Waitea* in Species Fungorum, GenBank, UNITE, and Hyde et al. (2024a) is under *Corticiaceae*, whereas MycoBank lists it under *Ceratobasidiaceae* and may need updating. Currently, Species Fungorum (2026) lists nine species of *Waitea*.

The basidiomata of the genus are composed of wide rhizoctonia-like basal hyphae giving rise to narrower, erect, hyaline hyphae which produce irregular cymose clusters of basidial initials that are characteristically involute, circinate, or even coiled. All hyphae lack clamp connections (Warcup & Talbot 1962). Basidia may be more or less cylindrical but more often develop by a prolongation from a subglobose probasidium, whereas sterigmata are usually four, curved and horn-like. Basidiospores are hyaline, smooth, inamyloid, oblong or broadly ellipsoid, bearing a prominent, truncate apiculus. Sclerotia are up to 2 mm in diameter and pinkish or orange, but in some strains eventually turn brown. No conidial state is known (Warcup & Talbot 1962).

The most well-known species is *Waitea circinata*, which can cause turfgrass disease known as “Waitea patch” or brown ring patch. This species is particularly problematic in golf courses and lawns, where it affects cool-season grasses (Hannan & Cushnahan 2010, Chang & Lee 2016).

Synonym: *Chrysorhiza* T.F, Andersen & Stalpers

Type species: *Waitea circinata* Warcup & P.H.B. Talbot

Other accepted species:

W. agrostidis J.A. Crouch & Cubeta

W. arvalis (Burds.) Ghobad-Nejhad
W. guianensis G. Gruhn & Ghobad-Nejhad
W. lakhanpalii S. Rana & S.K. Singh
W. nuda Clémençon
W. oryzae J.A. Crouch & Cubeta
W. prodiga J.A. Crouch & Cubeta
W. zeae (Voorhees) J.A. Crouch & Cubeta

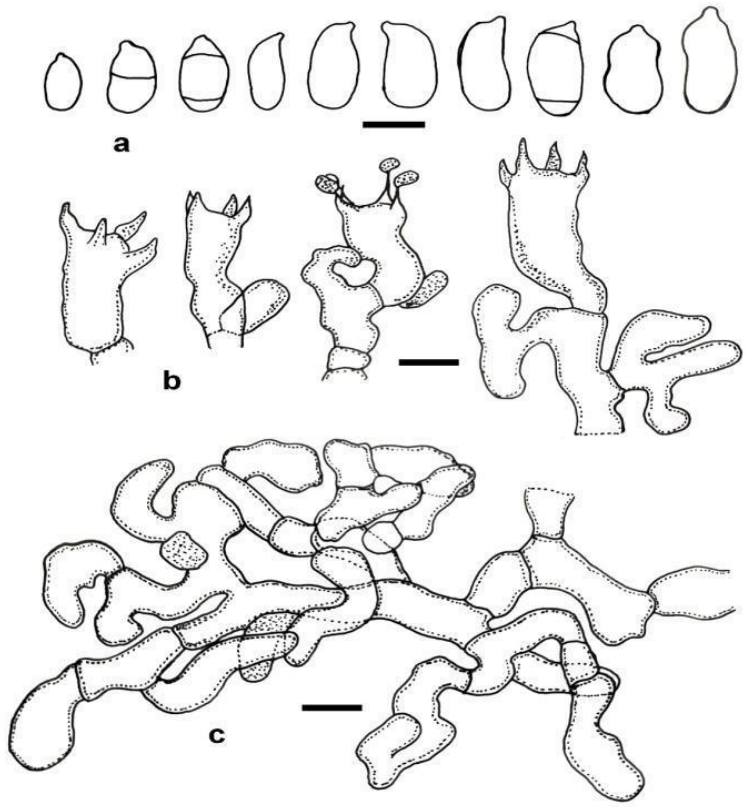


Fig. 191 – ***Waitea circinata***. a Basidiospores. b Basidia. c convoluted branching of hyphae before hymenium formation. Scale bars: a–c = 5 µm. Redrawn from Warcup & Talbot (1962).

Corticiales genera incertae sedis

Corticirama Pilát, Beihefte zur Sydowia 1, 128
Species Fungorum, Facesoffungi, MycoBank Fig. 192
Classification: *Incertae sedis*, *Corticiales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Corticirama, derived from the names of two other genera, *Corticium* and *Ramaria,* is a clavarioid genus described by Pilat (1957) to accommodate *C. petrakii* Pilát as the type species. Members belonging to this genus are characterised as corticiform fungus when young, attached to substratum by means of a thinly tunicated, simple, irregularly interwined, network of monomitic hyphae, covered with a fertile layer of hymenium, followed by a sterile and byssoid-fimriated margin like *Corticium* verum (Pilat 1957). Later, from the subicular, corticiform stage, a ramified or ramaria-like structure originates, which is also covered with a hymenium layer similar to the corticiform state. Basidiospores are smooth, hyaline, unguttulated, and non-amyloid (Pilat 1957).

The members are mostly wood-decaying, growing on the stems of *Umbelliferae* and *Athyrium distentifolium* (Pilat 1957, Schmid-Heckel 1988), thus playing roles as decomposers essential for maintaining healthy and productive environments. The species included in the genus are distributed in Germany and Serbia (Pilat 1957). No molecular studies have been conducted on

this group (He et al. 2019). However, the genus has been reported to be related to *Lentaria* Corner, but the former is differentiated by its thin-walled and non-inflated monomitic hyphae at maturity, basidiospores with oil drops, and more coticium-type anatomically than clavarioid (Pilat 1957).

The classification of *Corticirama* in He et al. (2024) and Hyde et al. (2024a) is under *Corticiales* genera *incertae sedis*, whereas Species Fungorum, MycoBank, and UNITE list it under *Corticiaceae* and may need updating. Currently, Species Fungorum (2026) lists two species of *Corticirama*.

Type species: *Corticirama petrakii* Pilát

Other accepted species: *C. berchtesgadensis* E. Ludw. & Schmid-Heckel

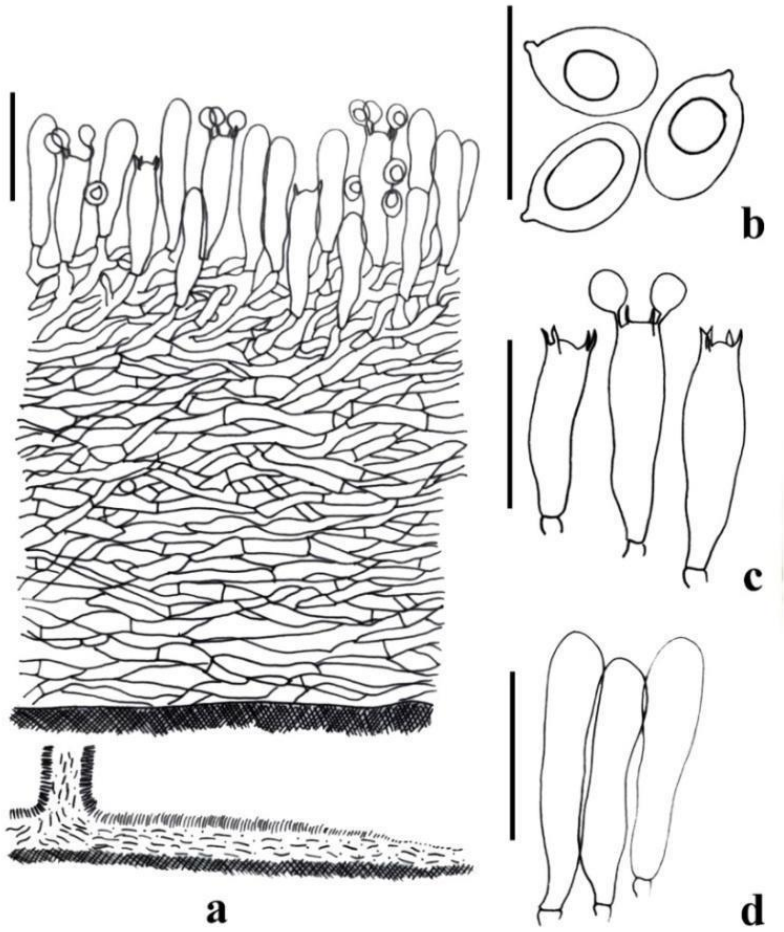


Fig. 192 – ***Corticirama petrakii*** (holotype). a Subiculum resupinatum fertile dissected schematically delineated above with spores, and below the margin of the subiculum "calvariae" part, basal. b Basidiospores. c Basidia. d Basidiole. Scale bars: a = 50 μm, b–d = 10 μm. Redrawn from Pilat (1957). For original basidiomata, refer to Pilat (1957).

Gloeophyllales Thorn, Hibbett et al., Mycological Research 111(5), 540

Species Fungorum, Facesoffungi, MycoBank, GenBank

Gloeophyllaceae Jülich, Bibliotheca Mycologica 85, 368

Species Fungorum, Facesoffungi, MycoBank, GenBank

Classification: *Gloeophyllales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Gloeophyllaceae was established by W. Jülich (1982) with *Gloeophyllum* P. Karst. as the type genus (Jülich 1982). The family consists of ten genera: *Boreostereum* Parmasto, *Chaetodermella* Rauschert, *Gloeophyllum*, *Griseoporia* Ginns, *Heliocybe* Redhead & Ginns, *Hispidaedalea* Y.C. Dai & S.H. He, *Neolentinus* Redhead & Ginns, *Osmoporus* Singer,

Paratrichaptum Corner, and *Veluticeps* Cooke (He et al. 2024, Hyde et al. 2024a). Members of *Gloeophyllaceae* are distributed worldwide and are saprophytic, causing brown rot on wood (He et al. 2019). Some species are edible, including *Neolentinus lepideus* (Fr.) Redhead & Ginns (Dai et al. 2010), and some species are medicinal, such as *N. adhaerens* (Alb. & Schwein.) Redhead & Ginns (Dai & Yang 2008).

Chaetodermella Rauschert, Haussknechtia 4, 52

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 193

Classification: *Gloeophyllaceae, Gloeophyllales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

In 1982, Malencon classified a specimen collected from Sweden under the name *Chaetoderma luna* (Romell ex D.P. Rogers & H.S. Jacks.) Parmasto (Malencon 1982). However, this epithet was invalid, being a homonym of the algal genus *Chaetoderma* Kützing (Larsson et al. 2020). Thus, Rauschert established the genus *Chaetodermella* in 1988 to accommodate this species (Larsson et al. 2020). Subsequently, another new species, *C. incrassata,* was also included in the genus (Larsson et al. 2020). Currently, Species Fungorum (2026) lists two species of *Chaetodermella*.

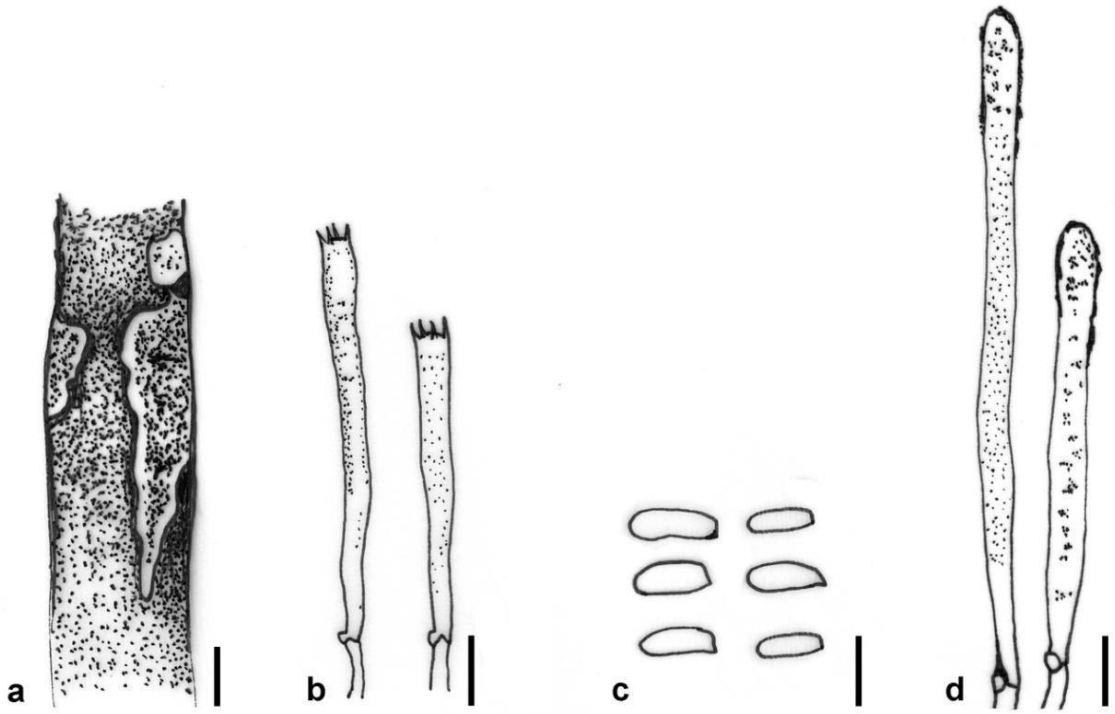


Fig. 193 – ***Chaetodermella incrassata***. a Basidiomata showing a hymenial surface on decaying wood. b Basidia. c Basidiospores. d Cystidia. Scale bar: a = 1 cm, b–d = 10 µm. Redrawn from Ram et al. (2021). For original basidiomata, refer to Ram et al. (2021).

The basidiomata of *Chaetodermella* species are resupinate, thick, dense, pale grey to ochraceous, and often exhibit a rimose texture (Ginns 1998). Basidiospores are cylindrical to suballantoid, thin-walled, and smooth. Basidia are clavate to cylindrical, elongated, basally clamped, and bear four sterigmata. Cystidia are long, clavate to cylindrical, thick-walled, and clamped at the base (Ginns 1998, Ram et al. 2021). The hyphal system is monomitic with clamped generative hyphae (Ram et al. 2021). A phylogenetic analysis indicates *Chaetodermella luna* forming a sister clade to *Veluticeps berkeleyana* Cooke (Garcia-Sandoval et al. 2011). *Chaetodermella luna* causes a brown rot on fallen logs of *Larix sibirica*, *Picea obovate,* and *Pinus syvestris* in coniferous forests (Ginns 1998, Ezhov & Zmitrovich 2015). The classification of

Chaetodermella in *Gloeophyllaceae, Gloeophyllales, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* agrees in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Synonymy: *Chaetoderma* Parmasto

Type species: *Chaetodermella luna* (Romell ex D.P. Rogers & H.S. Jacks.) Rauschert

Basionym: *Peniophora luna* Romell ex D.P. Rogers & H.S. Jacks.

Other accepted species:

Chaetodermella incrassata (Malençon) K.H. Larss. & Ryvarden

Gloeophyllales genera incertae sedis

Campylomyces Nakasone, Sydowia 56(2), 261

Species Fungorum, Facesoffungi, MycoBank Fig. 194

Classification: *Incertae sedis, Gloeophyllales, Agaricomycetes, Agaricomycotina, Basidiomycota*, *Fungi*

In the revisionary study of *Veluticeps* Cooke, *Pileodon* P. Roberts & Hjortstam, and related taxa by Nakasone (2004), *Campylomyces* was established to accommodate two species of *Veluticeps*, *V. tabacina* (Cooke) Burt and *V. heimii* Malençon. The contrasting characters of the two closely resembling genera, *Veluticeps* and *Campylomyces,* were thoroughly studied to justify the classification of *Campylomyces* (Nakasone 2004). Though both genera consist of a brown hyphal peg, large basidiospores, and basidia, they can be easily differentiated based on the texture, shape, and potassium hydroxide (KOH) reaction of basidiomata (Nakasone 2004).

Campylomyces is characterised by its small, perennial or annual, sessile, campanulate, cupulate, and sub-gelatinous basidiomata with a strigose outer layer. The hymenophore comprises many sterile hyphal pegs with no macrochemical reaction with KOH. The hyphal system is monomitic, consisting of pinnate, gelatinous hyphae. The basidiospores are hyaline, cylindrical, and inamyloid with a distinct apiculus and smooth surface (Nakasone 2004).

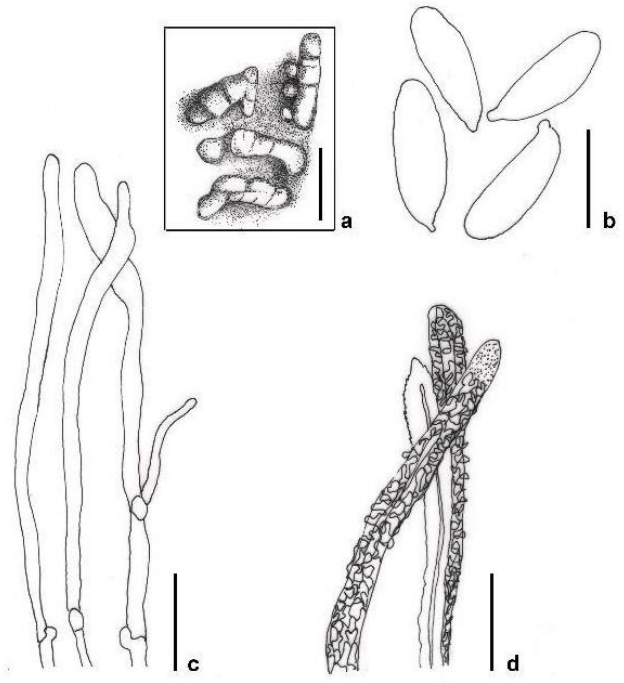


Fig. 194 – ***Campylomyces tabacinus*** (K(M)103894, holotype). a Cluster of dried basidiomata. b Basidiospores. c Basidioles. d Hyphal peg composed of thick-walled tramal cystidia coated with brown, mucilaginous materials. Scale bars: a = 2 mm, b–d = 20 µm. Redrawn from Nakasone (2004).

The original identification of the type species, *Campylomyces tabacinus* (Cooke) Nakasone, was *Aleurodiscus tabacinus* Cooke by Cunningham (1963), and with its unique features, he suggested that this species "could well be made the type of a separate genus" (Nakasone 2004). *Campylomyces tabacinus* is characterised by its typical lobate, cupulate basidiomata with brown hyphal pegs in hymenophore (Nakasone 2004). The identifying character of this species is the subicular and subhymenial hyphae with gelatinous walls and unique blue content and walls of the pileus hairs (Nakasone 2004). This species is somewhat morphologically similar to *Campylomyces heimii* (Malençon) Nakasone, but can be distinguished by the much larger basidioles and basidiospores of *C. tabacinus* (Nakasone 2004). *Campylomyces tabacinus* is considered to be rare, owing to its documentation from Australia from only two sites (Nakasone 2004).

The establishment of *Campylomyces* with its two species was based solely on morphological features. No molecular data of this genus has been found. The classification of *Campylomyces* in He et al. (2024) and Hyde et al. (2024a) is under *Gloeophyllales* genera *incertae sedis*, whereas Species Fungorum, MycoBank, and UNITE list it under *Gloeophyllaceae* and may need updating. Currently, Species Fungorum (2026) lists two species of *Campylomyces*.

Type species: *Campylomyces tabacinus* (Cooke) Nakasone

Basionym: *Aleurodiscus tabacinus* Cooke

Other accepted species: *Campylomyces heimii* (Malençon) Nakasone

Pileodon P. Roberts & Hjortstam, in Hjortstam, Roberts & Spooner, Kew Bulletin 53(4), 817

Species Fungorum, Facesoffungi, MycoBank Fig. 195

Classification: *Incertae sedis, Gloeophyllales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Pileodon was established by Roberts & Hjorstam (1998) with *P. megasporus* as the type species (Hjortstam et al. 1998, Nakasone 2004). The basidiomata of *Pileodon* are tough, woody, perennial, sessile, and effuse-reflexed, and the hymenial surface is finely odontioid and uniformly brown (Hjortstam et al. 1998). Basidiospores are large, initially hyaline and later brown, thin to slightly thick-walled, inamyloid, indextrinoid, and acyanophilous. Basidia are large, stalked, and each bearing four sterigmata. Cystidia are absent. The hyphal system is dimitic, with hyaline, clamped generative hyphae, and thick-walled, often nodulose skeletal hyphae (Hjortstam et al. 1998).

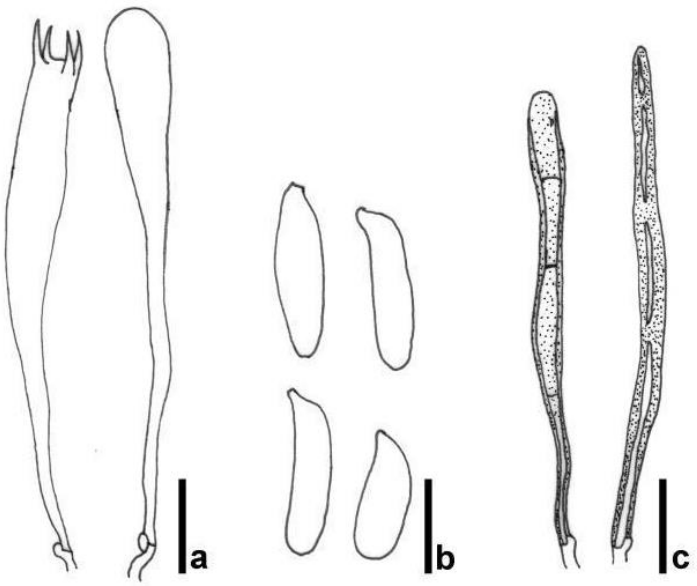


Fig. 195 – ***Pileodon philippinensis*** (lectotype, K(M) 102896). a Mature and immature basidium. b Basidiospores. c Skeletal cystidia from hyphal pegs. Scale bar: a–c = 10 µm. Redrawn from Nakasone (2004). For original basidiomata, refer to Nakasone (2004).

Pileodon is rare, with only two species, *P. megasporus* (Hjortstam et al. 1998) and *P. philippinensis* (Nakasone 2004). There is no molecular evidence to support these classifications (He et al. 2019). *Pileodon* shares some similarities with *Veluticeps* and *Campylomyces* (Nakasone 2004). However, the basidiomata of *Pileodon* and *Veluticeps* are large, thick, pileate to effuse-reflexed, tough, and woody, in contrast to *Campylomyces*, whose basidiomata are small, thin, cupulate with involute, free margins, and have a ceraceous texture (Nakasone 2004). Additionally, the tissues of *Pileodon* and *Veluticeps* exhibit a xanthochroic reaction, which is only temporary in *Campylomyces* (Nakasone 2004). Moreover, *Pileodon* blackens in KOH, unlike *Campylomyces* (Nakasone 2004). The classification of *Pileodon* in Species Fungorum and Hyde et al. (2024a) is under *Gloeophyllales* genera *incertae sedis*, whereas MycoBank and UNITE list it under *Gloeophyllaceae* and may need updating.

Type species: *Pileodon megasporus* P. Roberts & Hjortstam

Other accepted species: *P. philippinensis* (Bres.) Nakasone

Polyporales Gäum., Vergleichende Morphologie der Pilze (Jena), 503

Species Fungorum, Facesoffungi, MycoBank, GenBank

Adustoporiaceae Audet, Mushrooms nomenclatural novelties 12, 1

Species Fungorum, Facesoffungi, MycoBank, GenBank

Classification: *Polyporales, Agaricomycetes, Agaricomycotina*, *Basidiomycota*, *Fungi*

Adustoporiaceae is a recently established family within *Polyporales*, and is characterised by the basidiomata that range from annual to perennial, appearing resupinate to effused-reflexed, with a texture varying from corky to woody and poroid hymenophore (Liu et al. 2023a, Hyde et al. 2024a). The mycelium can be either monomitic or dimitic, with clamped generative hyphae. Cystidia are absent, while cystidioles may or may not be present. Basidiospores are allantoid, cylindrical to oblong ellipsoid, hyaline, thin-walled, smooth, and test negative for IKI and CB (Liu et al. 2023a, Hyde et al. 2024a). *Adustoporiaceae* was established based on morphology and phylogenetic analyses with combined LSU, SSU, *tef1*, *rpb1*, and *rpb2* gene regions (Audet 2018, Liu et al. 2023a). The family consists of six genera: *Adustoporia* Audet, *Amyloporia* Singer, *Austroporia* B.K. Cui & Shun Liu, *Lentoporia* Audet, *Resinoporia* Audet, and *Rhodonia* Niemelä (Liu et al. 2023a, Hyde et al. 2024a). However, they were previously grouped under *Antrodia sensu lato*. Previously reported families, *Amyloporiaceae* Audet, *Lentoporiaceae* Audet, *Caloporaceae* Bondartseva, and *Rhodoniaceae* Audet, are synonymised to *Adustoporiaceae* (Liu et al. 2023a, Hyde et al. 2024a).

Rhodonia Niemelä, Karstenia 45(2), 79

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 196

Classification: *Adustoporiaceae, Polyporales, Agaricomycetes, Agaricomycotina*, *Basidiomycota*, *Fungi*

Phylogenetic analysis based on ITS and LSU sequence data of *Postia* Fr. and related species by Pildain & Rajchenberg (2013) supported the erection of *Rhodonia* to accommodate *Postia placenta* (Fr.) M.J. Larsen & Lombard (Boidin et al. 1998, Kim et al. 2001, Binder et al. 2005, Niemelä et al. 2005, Shen et al. 2019). The separation of this species and the need for its own genus were strongly supported by molecular studies that revealed its distant relatedness to *Postia,* and it formed a monophyletic clade near *Antrodia* P. Karst. (Niemelä et al. 2005). Later, Ortiz-Santana et al. (2013) confirmed the independent lineage of *Rhodonia*. *Postia placenta,* which is currently accepted as *Rhodonia placenta* (Fr.) Niemelä, K.H. Larss. & Schigel became the type species of *Rhodonia* (Niemelä et al. 2005). This species has been well studied by Ryvarden & Gilbertson (1994) and Bernicchia (2005).

Rhodonia, derived from the Greek word "*rhodon*" meaning a name of rose, refers to the pale pink colour of the poroid hymenium (Niemelä et al. 2005). The characteristics of the genus include its annual, pileate to resupinate, thick but soft and watery basidiomata with a poroid hymenophore.

The hyphae in the monomitic hyphal system show clamp connections. The hyphae in the young basidiomata are thin-walled, but some turn to thick-walled and subsolid, which gives an impression of a dimitic hyphal system. The basidiospores are cylindrical. *Rhodonia* causes brown rot, especially in conifers (Niemelä et al. 2005).

Previously, *Rhodonia* was placed under a new family, *Rhodoniaceae*, proposed by Audet (2018) but without any concrete data and phylogeny, and thus was soon rejected by many researchers (Runnel et al. 2019, Liu et al. 2023a). Since then, the genus has been classified under uncertain familial placements (*Incertae sedis*) within *Polyporales* Gäum. (Liu et al. 2023a). The classification of *Rhodonia* in MycoBank, GenBank, and Hyde et al. (2024a) is under *Adustoporiaceae*, whereas Species Fungorum and UNITE list it under *incertae sedis* and may need updating. Currently, Species Fungorum (2026) lists six species of *Rhodonia*.

In addition to the type species, the integrative approach of morphology and phylogeny (ITS, LSU, and *rpb2*) further transferred *Postia obliqua* Y.L. Wei & W.M. Qin, *P. rancida* (Bres.) M.J. Larsen & Lombard, and *P. subplacenta* B.K. Cui to *Rhodonia* (Yuan & Shen 2017).

Synonym: *Caloporus* P. Karst., *Caloporus* Quél.

Type species: *Rhodonia placenta* (Fr.) Niemelä, K.H. Larss. & Schigel

Basionym: *Polyporus placenta* Fr.

Other species:

R. obliqua (Y.L. Wei & W.M. Qin) B.K. Cui, L.L. Shen & Y.C. Dai

R. rancida (Bres.) B.K. Cui, L.L. Shen & Y.C. Dai

R. subplacenta (B.K. Cui) B.K. Cui, L.L. Shen & Y.C. Dai

R. subrancida B.K. Cui & Shun Liu

R. tianshanensis Yuan Yuan & L.L. Shen

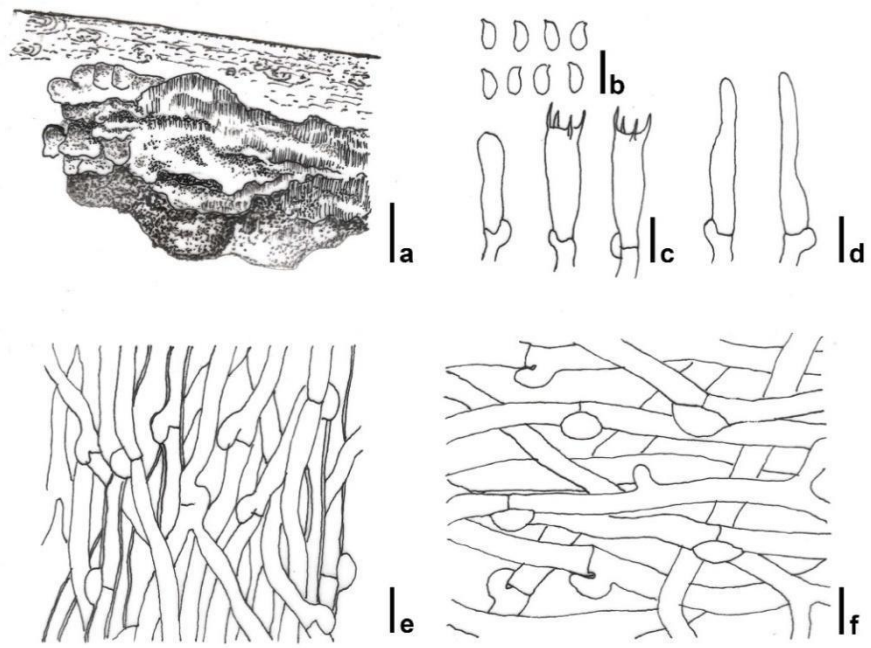


Fig. 196 – ***Rhodonia tianshanensis*** (holotype). a Basidiomata. b Basidiospores. c Basidiole and Basidia. d Cystidioles. e Hyphae from trama. f Hyphae from context. Scale bars: a = 2.5 cm, b–f = 10 μm. Redrawn from Yuan & Shen (2017).

Cerrenaceae Miettinen, Justo & Hibbett, Justo et al., Fungal Biology 121(9), 817

Species Fungorum, Facesoffungi, MycoBank, GenBank

Classification: *Polyporales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Cerrenaceae is a small family established by O. Miettinen, A. Justo & D.S. Hibbett in 2017 and typified by *Cerrena* Gray (Justo et al. 2017). The family consists of 7 genera: *Acanthodontia* Miettinen & Spirin, *Cerrena*, *Irpiciporus* Murrill, *Lividopora* Miettinen, *Pseudolagarobasidium* J.C. Jang & T. Chen, *Pseudospongipellis* Y.C. Dai & Chao G. Wang, and *Radulodon* Ryvarden (Hyde et al. 2024a). *Cerrenaceae* is characterised by effused to pileate basidiomata, poroid, labyrinthine or spinose hymenophore, monomitic to trimitic hyphal system with clamps, presence or absence of cystidia, and smooth, non-amyloid, non-dextrinoid basidiospores (Justo et al. 2017, Nakasone & Ortiz-Santana 2022). Members of this family are distributed worldwide and are mostly saprophytic, causing white-rot in wood, while some species are serious pathogens, endophytes, or symbionts with insects (Nakasone & Ortiz-Santana 2022, Miettinen et al. 2023).

Radulodon Ryvarden, Journal of Botany 50(10), 2073

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 197

Classification: *Cerrenaceae, Polyporales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Radulodon was established by Ryvarden, with *R. americanus* as the type species (Ryvarden 1972), and later redefined by Nakasone (2001). Species of *Radulodon* are saprophytic with a cosmopolitan distribution, mainly in the Northern Hemisphere (Wang & Dai 2022). Within *Radulodon*, Species Fungorum (2025) lists seven species worldwide. Recently, *R. yunnanensis* Y.C. Dai & Chao G. Wang was described from China, based on morphological characteristics and multi-gene phylogenetic analyses (ITS, LSU, SSU, and *tef-1α*) (Wang & Dai 2022). The classification of *Radulodon* in *Cerrenaceae, Polyporales, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* agrees in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

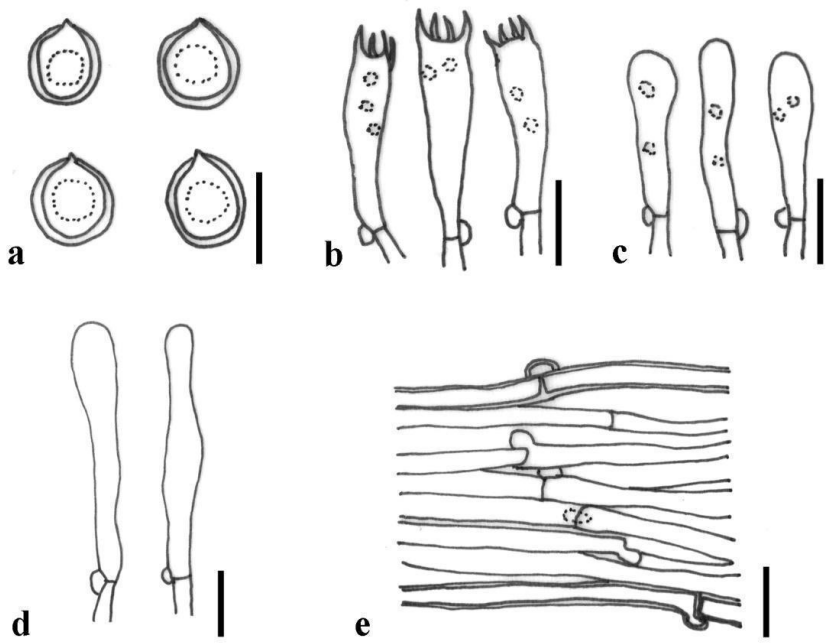


Fig. 197 – ***Radulodon yunnanensis*** (Dai 12204). a Basidiospores. b Basidia. c Basidioles. d Cystidia. e Hyphae from subiculum. Scale bar: a = 5 µm, b–e = 10 µm. Redrawn from Wang & Dai (2022). For original basidiomata, refer to Wang & Dai (2022).

Members of *Radulodon* are characterised by resupinate to effused-reflexed, ceraceous basidiomata, with a hydnoid hymenophore composed of conical, cylindrical, or flattened spines (Ryvarden 1972, Nakasone 2001, Wang & Dai 2022). Basidiospores are ellipsoid, subglobose to globose, hyaline, thin-to slightly thick-walled, and slightly cyanophilous (Wang & Dai 2022).

Basidia are clavate, 4-spored, and with basal clamp connections (Nakasone 2001). Cystidia are clavate, obclavate to cylindrical with basal clamp connections. The hyphal system is dimitic; generative hyphae with clamp connections and sometimes with rarely or frequently branched micro-binding hyphae or thick-walled skeletal hyphae limited to the subiculum and base of spines (Nakasone 2001, Wang & Dai 2022).

Phylogenetically, *Radulodon* is a sister genus to *Irpiciporus* Murrill in *Cerrenaceae* Miettinen; however, the latter is distinct by having a monomitic hyphal system and a lack of cystidia (Murrill 1905a, Kotlába & Pouzar 1957, Wang & Dai 2022). Morphologically, *Radulodon* resembles *Pseudolagarobasidium* J.C. Jang & T. Chen, yet both form distinct monophyletic groups in multi-gene phylogenetic analyses (Nakasone & Ortiz-Santana 2022). Additionally, *Pseudolagarobasidium* differs by its soft to firm basidiomata and non-agglutinated hyphae (Nakasone & Ortiz-Santana 2022).

Type species: *Radulodon americanus* Ryvarden

Other accepted species:

R. acaciae G. Kaur, Avn.P. Singh & Dhingra
R. casearius (Morgan) Ryvarden
R. erikssonii Ryvarden
R. indicus Jyoti & Dhingra
R. yunnanensis Y.C. Dai & Chao G. Wang
R. pyriformis Hjortstam & Ryvarden

Irpicaceae Spirin & Zmitr., Mycena 3, 48

Species Fungorum, Facesoffungi, MycoBank, GenBank

Classification: *Polyporales*, *Agaricomycetes*, *Agaricomycotina*, *Basidiomycota*, *Fungi*

Irpicaceae is a relatively small but phylogenetically well-defined family within *Polyporales* Gäum. (Spirin 2003, Justo et al. 2017, Chen et al. 2021). The family includes 14 genera: *Byssomerulius* Parmasto, *Candelabrochaete* Boidin, *Ceriporia* Donk, *Crystallicutis* El-Gharabawy, Leal-Dutra & G.W. Griff., *Cytidiella* Pouzar, *Flavodontia* C.L. Zhao, *Gloeoporus* Mont., *Irpex* Fr., *Leptoporus* Quél., *Meruliopsis* Bondartsev, *Phanerochaetella* C.C. Chen & Sheng H. Wu, *Raduliporus* Spirin & Zmitr., *Resiniporus* Zmitr., and *Trametopsis* Tomšovský (Hyde et al. 2024a). Members typically form resupinate to pileate basidiomata, have a monomitic hyphal system with septate hyphae, thin-walled, smooth, non-amyloid, and acyanophilous basidiospores, and generally lack cystidia (Li et al. 2022b). Most species cause white-rot decay on woody angiosperms, except *Leptoporus* Quél., which produces brown-rot decay (Chen et al. 2021). The type genus *Irpex* Fr. was erected by Fries (1825). Global sampling by Li et al. (2022b) recognised nine clades within *Irpicaceae*, describing seven new species and proposing new combinations, which highlights East Asia as a diversity hotspot for the family.

Ceriporia Donk, Mededelingen van de Nederlandse Mycologische Vereeniging 2, 170

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 198

Classification: *Irpicaceae*, *Polyporales*, *Agaricomycetes*, *Agaricomycotina*, *Basidiomycota*, *Fungi*

Ceriporia was circumscribed by Donk in 1933, with *C. viridans* (Berk. & Broome) Donk designated as the type species. The genus was segregated from other poroid crust fungi based on its resupinate basidiomata with poroid hymenophores, a monomitic hyphal system, and hyaline, thin-walled spores (Jia et al. 2014, Chen et al. 2020). Initially placed within *Phanerochaetaceae* Jülich, *Ceriporia* has since undergone extensive revision, and recent multigene phylogenetic analyses revealed that the genus is polyphyletic, with species distributed across *Irpicaceae* Spirin & Zmitr., *Phanerochaetaceae*, and *Meruliaceae* Rea. As a result, several species previously assigned to *Ceriporia* have been recombined into other genera, including *Meruliopsis* Bondartsev (Chen et al. 2020). Species of *Ceriporia* are white-rot fungi that occur on decaying wood in forest ecosystems

and are widely distributed across temperate, subtropical, and tropical regions, including Asia, Europe, the Americas, and Africa (Jia et al. 2014, Chen et al. 2020).

The basidiomata of *Ceriporia* species are typically resupinate, occasionally effused-reflexed, and crust-like, firmly adhering to the wood substrate. The hymenophore may be poroid or smooth, with surface colours ranging from white and buff to vivid tones such as violet, pink, or yellow (Chen et al. 2020). The hyphal system is monomitic, consisting of generative hyphae with simple septa and, rarely, clamp connections. The basidiospores are hyaline, thin-walled, and vary in shape from ellipsoid to cylindrical or allantoid (Chen et al. 2020, Wang et al. 2023).

The classification of *Ceriporia* in *Irpicaceae*, *Polyporales*, *Agaricomycetes*, *Agaricomycotina*, and *Basidiomycota* is in agreement in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of fungi (Hyde et al. 2024a). The taxonomy of *Ceriporia* remains problematic because the genus is demonstrably polyphyletic, with species scattered across *Irpicaceae*, *Phanerochaetaceae*, and *Meruliaceae*. While Chen et al. (2020) and Wang et al. (2023) attempted to resolve this using multilocus phylogenies, many species have not yet been sequenced, and cryptic lineages remain. Multigene phylogenetic analyses based on ITS, LSU, and *rpb1* support the conclusion that *Ceriporia* is polyphyletic. *Ceriporia lacerata* N. Maek., Suhara & R. Kondo (current name: *Irpex laceratus* (N. Maek., Suhara & R. Kondo) C.C. Chen & Sheng H. Wu) genome sequencing confirmed its position in *Polyporales* and revealed abundant CAZyme genes, reinforcing the role of the genus in lignocellulose degradation (Chen et al. 2020, Mao et al. 2022). Within *Ceriporia,* Hyde et al. (2024a) recognised approximately 50 species worldwide.

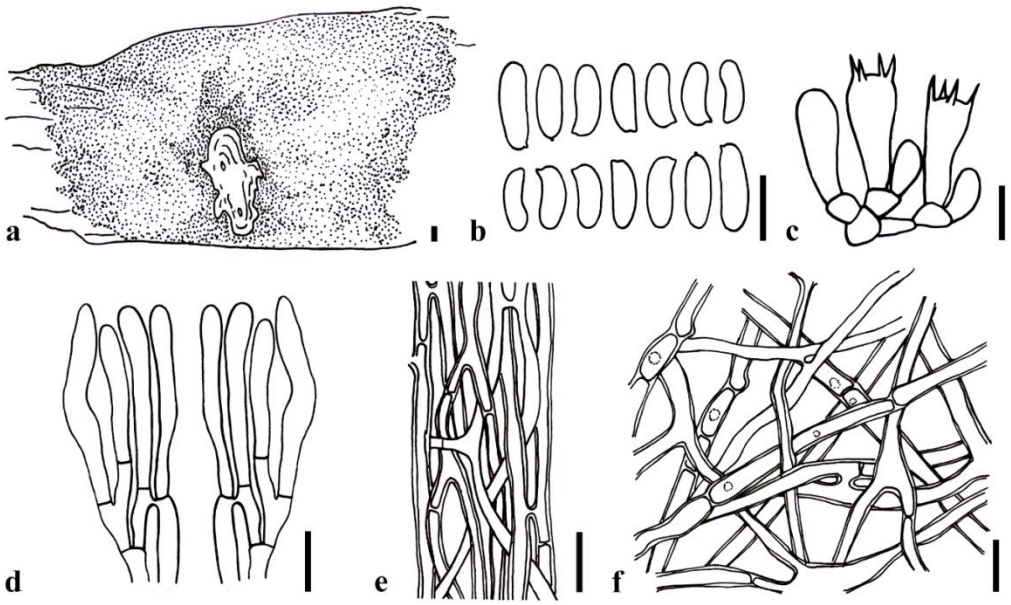


Fig. 198 – ***Ceriporia mellita***. a Basidiomata. b Basidiospores. c Basidia. d Hyphoid sterile elements from the dissepiment edge. e Hyphae from the tube trama. f Hyphae from subiculum. Scale bars: a = 1 mm, b−c = 5 µm, d−f = 10 µm. Redrawn from Chen et al. (2020). For original basidiomata, refer to Chen et al. (2020).

Species of *Ceriporia* are saprotrophs or endophytes inhabiting deadwood in forests, degrading lignin via ligninolytic enzymes, such as laccases, manganese peroxidases, and lignin peroxidases. Some species, such as *Ceriporia lacerata,* have shown abilities to decolourise synthetic dyes (e.g., Congo red), degrade PCBs in soil, and produce valuable secondary metabolites (ceriponols A–K), some with cytotoxicity, suggesting biotechnological and pharmaceutical potential (Mao et al. 2022).

Synonymy: *Ceraporus* Bondartsev & Singer

Type species: *Ceriporia viridans* (Berk. & Broome) Donk

Basionym: *Polyporus viridans* Berk. & Broome
Other accepted species: (Species Fungorum – search *Ceriporia*)

Irpex Fr., Systema Orbis Vegetabilis (Lundae), 81
Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 199
Classification: *Irpicaceae, Polyporales, Agaricomycetes, Agaricomycotina, Basidiomycota*, *Fungi*

Irpex was established by E.M. Fries in 1825, although no type species was specified (Fries 1825). Later, in 1828, *I. lacteus* was designated as the type species, which was initially classified as *Sistotrema lacteum*, based on specimens collected on a branch of *Fagus* in Sweden (Maas Geesteranus 1974). Members of *Irpex* are white-rot fungi that colonise dead wood and have a cosmopolitan distribution (He et al. 2019). Within *Irpex*, Hyde et al. (2024a) recognise approximately 75 species worldwide. The classification of *Irpex* in *Irpicaceae, Polyporales, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* agrees in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Irpex is characterised by effused basidiomata, effused-reflexed, or pileate, typically white, cream, yellowish, or cinnamon in colour (Maas Geesteranus 1974, Chen et al. 2021). The hymenophore is poroid, irpicoid, or hydnoid (Maas Geesteranus 1974). The hyphal system is dimitic, with generative hyphae that are simple-septate (Chen et al. 2021). Cystidia, when present, are tramal and subhymenial in origin, cylindrical, conical to subulate, thin- to thick-walled, and often apically or completely incrusted (Maas Geesteranus 1974, Zmitrovich et al. 2006, Lim & Jung 2003, Miettinen et al. 2007, Chen et al. 2021). Basidiospores are ellipsoid to somewhat allantoid, smooth, hyaline, inamyloid, acyanophilous. Basidia are cylindrical to clavate, 4-spored, and without a basal clamp (Maas Geesteranus 1974).

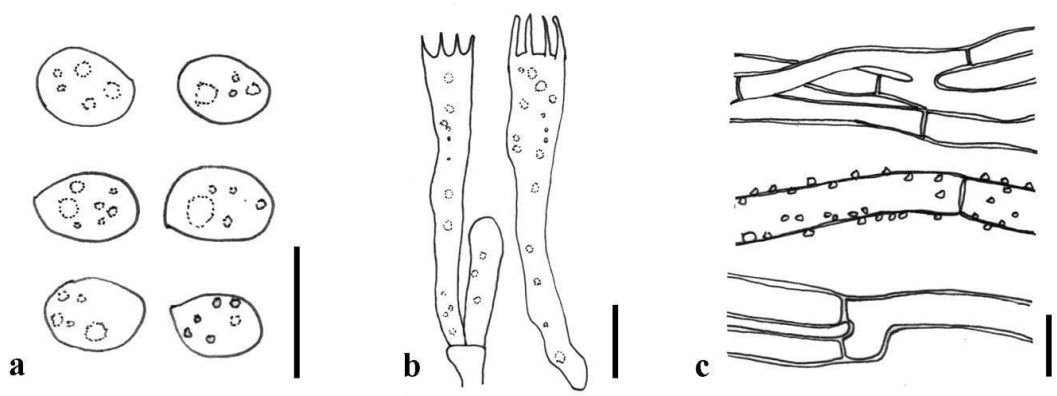


Fig. 199 – ***Irpex lenis*** (Wu 1608-22, holotype). a Basidiospores. b Basidia. c Subicular hyphae. Scale bar: a–c = 10 µm. Redrawn from Chen et al. (2021). For original basidiomata, refer to Chen et al. (2021).

Irpex lacteus has commercial importance due to the production of hydrolases (e.g., endo- and exo-cellulases) and extracellular oxidative enzymes (Lim & Jung 2003, Yao et al. 2017). This species exhibits resistance to pollutant toxicity and is efficient in biodegradation processes, potentially suitable for extracting ethanol through biological pretreatment of lignocellulose (Novotný et al. 2009, García-Torreiro et al. 2016). Notably, Yao et al. (2017) reported a whole-genome sequence of *I. lacteus* strain F17.

Synonymy: *Australohydnum* Jülich, *Beccaria* Cooke, *Cystidiophorus* Bondartsev & Ljub., *Flavodontia* C.L. Zhao, *Hydnopolyporus* D.A. Reid
Type species: *Irpex lacteus* (Fr.) Fr.
Basionym: *Sistotrema lacteum* Fr.
Other accepted species: (Species Fungorum – search *Irpex*)

Laricifomitaceae Jülich, Bibliotheca Mycologica 85, 375

Species Fungorum, Facesoffungi, MycoBank, GenBank

Classification: *Polyporales, Agaricomycetes, Agaricomycotina, Basidiomycota*, *Fungi*

Laricifomitaceae, phylogenetically part of the antrodia clade, is a major lineage containing most brown-rot polypores and is typified by *Laricifomes* Kotl. & Pouzar (Ortiz-Santana et al. 2013). It is a distinct and well-supported family separated from *Fomitopsidaceae* (Liu et al. 2023a). Previously, it was grouped within *Fomitopsidaceae*, but multi-gene phylogenetic analysis has confirmed *Laricifomitacea*e as a monophyletic family within the order *Polyporales* (Binder et al. 2013, He et al. 2019, Liu et al. 2023a). Members of the family are characterised by annual to perennial, pileate, resupinate or effused-reflexed basidiomata, poroid hymenophore, monomitic to dimitic hyphal system, absence of cystidia, presence of cystidioles, and ellipsoid, short-cylindric to drop-shaped, hyaline, thin- to thick-walled, smooth basidiospores, negative to IKI and CB (Liu et al. 2023a). This family consists of three genera: *Gilbertsonia* Parmasto, *Laricifomes*, and *Ryvardenia* Rajchenb. (He et al. 2024, Hyde et al. 2024a). Members typically cause brown cubical rot and produce perennial, leathery to corky basidiomata (Liu et al. 2023a).

Ryvardenia Rajchenb., Nordic Journal of Botany 14(4), 436

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 200

Classification: *Laricifomitaceae, Polyporales, Agaricomycetes, Agaricomycotina, Basidiomycota*, *Fungi*

Ryvardenia was established by M. Rajchenberg in 1994, with *R. cretacea* as the type species (Rajchenberg 1994, Kirk et al. 2013). The genus name was provided in honour of the polypore specialist Dr. Leif Ryvarden (Rajchenberg 1994). The type species was originally described as *Polyporus cretaceous* from specimens collected in Tasmania (Rajchenberg 1994). *Ryvardenia* is an annual, wood-rotting fungus that causes brown-rot, distributed in the Southern Hemisphere, including Argentina, Australia, Chile, and New Zealand (Rajchenberg 1994, He et al. 2019). The genus comprises only two recognised species (He et al. 2019). The classification of *Ryvardenia* in MycoBank, GenBank, and Hyde et al. (2024a) is under *Laricifomitaceae*, whereas Species Fungorum and UNITE list it under *incertae sedis* and may need updating. Currently, Species Fungorum (2026) lists two species of *Ryvardenia*.

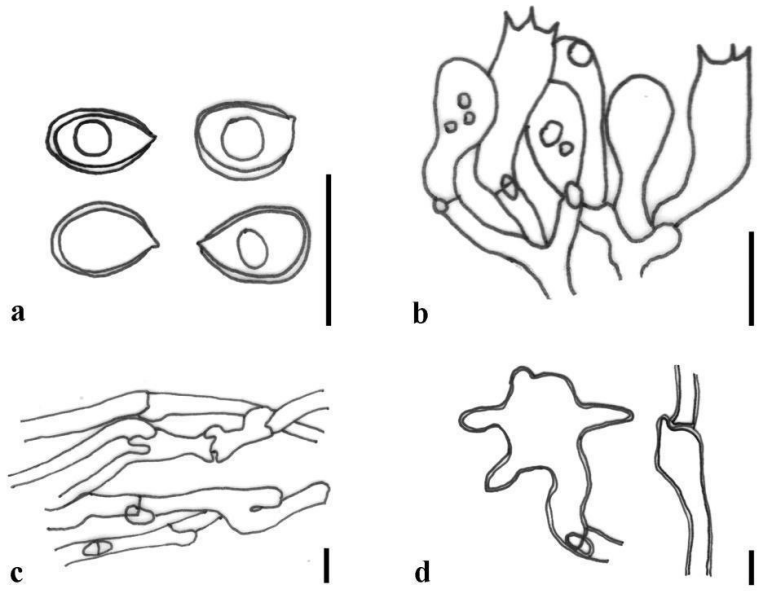


Fig. 200 – ***Ryvardenia cretacea***. a Basidiospores. b Basidia and basidioles. c Generative hyphae with thin-walls. d Distorted generative hyphae with thick walls. Scale bar: a–d = 10 µm. Redrawn from Rajchenberg (1994). For original basidiomata, refer to Rajchenberg (1994).

Members of *Ryvardenia* are characterised by medium to large-sized, piliate basidiomata (Rajchenberg 1994). Pileus surface is white or slightly yellowish, while the pore surface is whitish to yellowish-tan, with circular to angular pores. The context is chalk white, crumbly, or chalky (Liu et al. 2023a). Basidiospores are ellipsoid to drop-shaped, hyaline, thick-walled, uninucleate, and inamyloid (Rajchenberg 1994). Cystidia are absent (Liu et al. 2023a). The hyphal system is monomitic to dimitic; generative hyphae are clamped, thin- to thick-walled, while skeletal hyphae are few to abundant and are present only in the dissepiments. The generative hyphae of the advancing mycelium is simple septate (Rajchenberg 1994).

Phylogenetic analysis (ITS, LSU, SSU, *tef-1α*, *rpb1*, and *rpb2*) conducted by Liu et al. (2023a) on brown-rot fungi within *Polyporales* provided strong support in *Laricifomitaceae*, with *Ryvardenia* forming a monophyletic lineage (Pildain & Rajchenberg 2013, Liu et al. 2023a). Morphologically, *Ryvardenia* resembles *Fomitopsis s.s.* P. Karst., but differs in having annual basidiomata and a monomitic hyphal system (Rajchenberg 1994, Han et al. 2016).

Type species: *Ryvardenia cretacea* (Lloyd) Rajchenb.

Basionym: *Polyporus cretaceous* Lloyd

Other accepted species: *Ryvardenia campyla* (Berk.) Rajchenb.

Meruliaceae Rea, British Basidiomycetae (Cambridge), 620

Species Fungorum, Facesoffungi, MycoBank, GenBank

Classification: *Polyporales, Agaricomycetes, Agaricomycotina, Basidiomycota*, *Fungi*

Meruliaceae was erected by Rea in 1922, typified with *Merulius* Fr. (Gu et al. 2025). This family accommodates wood-inhabiting corticioid fungi, resupinate or pileate polypores, and pileate hydnaceous (Gu et al. 2025). Members of this family are characterised by a primarily monomitic or rarely dimitic hyphal system, simple septate hyphae, absence of cystidia, thin-walled, smooth, and hyaline basidiospores (Justo et al. 2017, Chen et al. 2021, Li et al. 2025, Gu et al. 2025). This family exhibits a strongly supported monophyletic clade in *Polyporales* upon multigene phylogenetic analyses using ITS, LSU, *rpb1*, *rpb2*, and *tef1*, and currently consists of 28 genera (Li et al. 2025, Gu et al. 2025). Previously described families, *Climacodontaceae* Jülich and *Phlebiaceae* Jülich, have been synonymised with *Meruliaceae*.

Mycoacia Donk, Mededeelingen van de Nederlandsche Mycologische Vereeniging 18–20, 150

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 201

Classification: *Meruliaceae, Polyporales, Agaricomycetes, Agaricomycotina, Basidiomycota*, *Fungi*

Mycoacia was established by Donk in 1931 as a replacement for the invalid name *Acia* P. Karst. (Donk 1931). The type species, *M. fuscoatra*, was initially classified as *Hydnum fuscoatrum* Fr., based on a specimen collected on a rotten trunk of *Fagus* in Sweden (Donk 1931). Nakasone (1997) later synonymised *Mycoacia* under *Phlebia* Fr. However, Chen et al. (2021) reported that *Mycoacia* form a distinct and well-supported clade in *Meruliaceae*, along with other genera such as *Ceriporiopsis* Domański, *Lilaceophlebia* (Parmasto) Spirin & Zmitr., *Phlebia*, and *Stereophlebia* Zmitr. Species of *Mycoacia* are annual, saprobic, and are distributed worldwide (Yuan & Wan 2012, He et al. 2019).

Mycoacia is characterised by ceraceous, effused, waxy, and strongly adnate basidiomata, exhibiting a hydnoid hymenophore with conical to cylindrical spines (Ragab 1951, Eriksson & Ryvarden 1976, Yuan & Wan 2012, Chen et al. 2021). The hyphal system is monomitic, with generative hyphae bearing either clamped or simple septate. Basidiospores are narrowly ellipsoid, cylindrical, or allantoid (Eriksson & Ryvarden 1976, Yuan & Wan 2012), while basidia are narrowly clavate. Cystidia are often present, subulate or fusiform (Chen et al. 2021).

Chen et al. (2021) utilised morphological characteristics and multilocus phylogenetic analyses (ITS, LSU, *rpb1*, *rpb2*, and *tef-1α*) to delineate at the genus level, including *Mycoacia*. Recently, Li et al. (2025) described a new species, *M. beijingensis*, in morphological characteristics and molecular clock analyses. Within *Mycoacia*, Species Fungorum (2025) lists only 17 species

worldwide. Notably, the tissue of the type species, *M. fuscoatra*, turns red immediately upon reaction to KOH, a diagnostic feature absent in other species within the genus (Chen et al. 2021). The classification of *Mycoacia* in *Meruliaceae, Polyporales, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* agrees in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Synonymy: *Acia* P. Karst., *Ceriporiopsis* Domański, *Gelatoporia* Niemelä, *Porpomyces* Jülich, *Pouzaroporia* Vampola, *Stereophlebia* Zmitr., *Taxomyces* Strobel, A. Stierle, D. Stierle & W.M. Hess

Type species: *Mycoacia fuscoatra* (Fr.) Donk

Basionym: *Hydnum fuscoatrum* Fr.

Other accepted species: (Species Fungorum – search *Mycoacia*)



Fig. 201 – ***Mycoacia beijingensis*** (He 9275, holotype). a Basidiomata. b Basidiospores. c Basidia. d Basidioles. e Leptocystidia. f Context hyphae. g Subiculum hyphae. Scale bar: a = 1 cm, b–g = 10 μm. Redrawn from Li et al. (2025). For original basidiomata, refer to Li et al. (2025).

Scopuloides (Massee) Höhn. & Litsch., Wiesner Festschrift (Wien), 57

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 202

Classification: *Meruliaceae, Polyporales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Scopuloides was initially described as a subgenus, *Peniophora* subgen. *Scopuloides*, typified with *S. hydnoides* (Cooke & Massee) Hjortstam & Ryvarden, characterised with fascicles of cystidia (Massee 1889), and later raised to genus level by Höhnel & Litschauer (Höhnel & Litschauer 1908). The genus belongs to the wood-decaying group (growing on fallen tree trunks) of fungi that cause white-rot, and is presently classified under *Meruliaceae* Rea, constituting a phebioid clade within *Polyporales* P. Karst. (Gu et al. 2024).

The species are characterised by ceraceous and white-buff coloured basidiomata (Chen et al. 2021, Gu et al. 2024). Hymenophore is grandinioid, odontioid, or hydnoid. Basidiospores are ellipsoidal, allantoid, cylindrical, and comparatively small. Subiculum, known for its compactness, is made up of agglutinated and more or less short-celled subicular hyphae. Basidia are short and small. Cystidia are lamprocystidia-type (Chen et al. 2021, Gu et al. 2024, 2025). The type species *Scopuloides hydnoides* was originally reported from England (Cooke & Massee 1872, Massee 1889). It is known for its unique features, including ceraceous, odontioid hymenium with distinct cracking, allantoid, ellipsoidal, hyaline, thin-walled, and inamyloid basidiospores, thick-walled,

branched generative hyphae, hymenium cystidia heavily encrusted (lamprocystidia), thick-walled, septate, cylindrical, and narrowly clavate basidia (Jülich 1982, Gu et al. 2025).

Within *Scopuloides,* Species Fungorum (2025) lists 13 species worldwide. Members of this genus are distributed globally in Asia, Europe, North America, and the Neotropics (Gu et al. 2025). Several molecular studies have been conducted based on ITS, LSU, *rpb1*, *rpb2*, and *tef-1α*, suggesting that the genus forms a monophyletic clade within *Meruliaceae* (Chen et al. 2021, Gu et al. 2024, 2025). *Scopuloides* is related to *Phanerochaete* P. Karst., belonging to the same order *Polyporales* Gäum., and shares similarities for odontoid hymenium, inamyloid basidiospores, and absence of clamps in hyphae, but *Phanerochaete* is differentiated by the presence of membranous and smooth hymenophore, loose subiculum, and cystidia either encrusted or naked (Wu et al. 2010a, Floudas & Hibbett 2015). The classification of *Scopuloides* in *Meruliaceae, Polyporales, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* agrees in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Synonym: *Peniophora* subgen. *Scopuloides* Massee

Type species: *Scopuloides hydnoides* (Cooke & Massee) Hjortstam & Ryvarden

Basionym: *Peniophora hydnoides* Cooke & Massee

Other accepted species: (Species Fungorum – search *Scopuloides*)

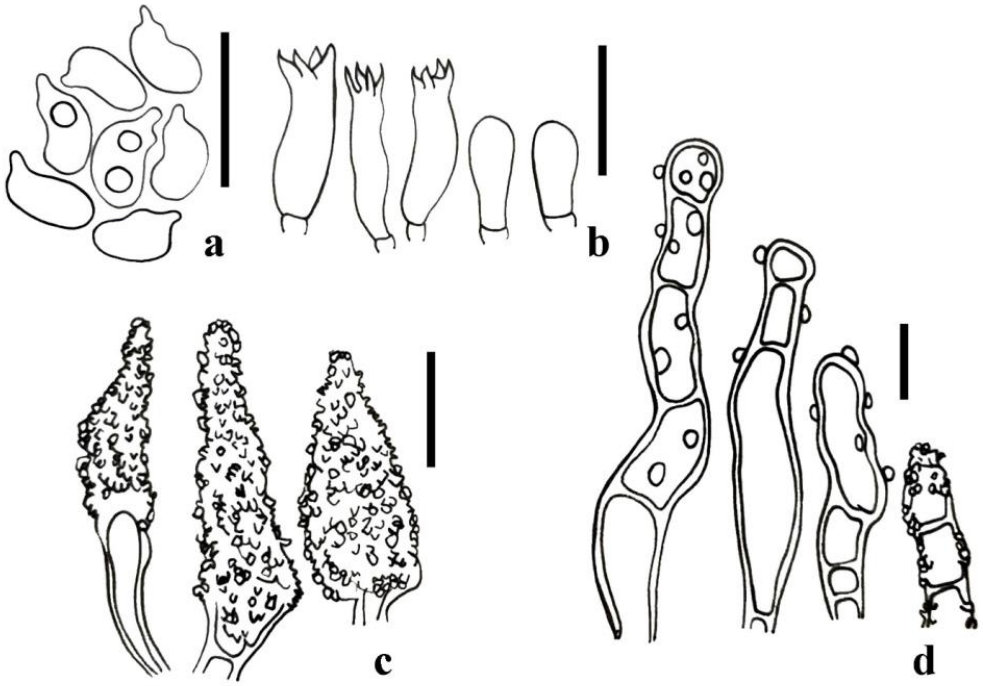


Fig. 202 – ***Scopuloides yunnanensis***. a Basidiospores. b Basidia and basidioles. c Lamprocystidia. d Septate cystidia. Scale bars: a–d = 10 μm. Redrawn from Gu et al. (2024).

Phanerochaetaceae Jülich, Bibliotheca Mycologica 85, 384

Species Fungorum, Facesoffungi, MycoBank, GenBank

Classification: *Polyporales, Agaricomycetes, Agaricomycotina, Basidiomycota*, *Fungi*

Phanerochaetaceae is a diverse group of corticioid fungi within the *Polyporales* Gäum., causing white-rot. This family was introduced by Eriksson (1958) as the subfamily *Phanerochaetoideae* within *Corticiaceae* Herter. It was later validly published by Parmasto (1986) and elevated to family rank by Jülich (1982). The type genus is *Phanerochaete* P. Karst. (Jülich 1982). Larsson (2007) later also proposed *Phanerochaetaceae* for a clade of corticioid fungi centred on *Phanerochaete*. Most members of this clade are corticioid or hydnoid, simple-septate and monomitic, except *Hapalopilus* P. Karst., a polypore with clamped hyphae (Miettinen et al.

2016). Most of the taxa are saprobic, found as wood decomposers, but some are reported from soil or litter (Justo et al. 2017). This family contains 27 genera worldwide (Hyde et al. 2024a).

Porostereum Pilát, Bulletin Trimestriel de la Société Mycologique de France 52(3), 330

Species Fungorum, Facesoffungi, MycoBank, GenBank

Classification: *Phanerochaetaceae, Polyporales, Agaricomycetes, Agaricomycotina, Basidiomycota*, *Fungi*

Porostereum was established by Pilát in 1937 with *P. phellodendri* as the type species (Pilát 1936). Members of the genus exhibit diverse lifestyles, including saprophytic, endophytic, and latent plant pathogens, and are distributed worldwide (Sarkar & Datta 2024). *Porostereum* is distinct from the closely related genus *Hjortstamia* Boidin & Gilles by consistently having clamped hyphae (Boidin & Gilles 2002, Wu et al. 2010a). Within *Porostereum*, Species Fungorum (2026) lists six species worldwide. Molecular data for the type species are not available; therefore, the phylogenetic concept of this genus still requires investigation (Xavier de Lima et al. 2020). The classification of *Porostereum* in *Phanerochaetaceae, Polyporales, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* agrees in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Porostereum is characterised by stereoid basidiomata with effuso-reflexed pileus, smooth hymenium surface (Welden 1975). The hyphal system is mono-dimitic, with clamped generative hypha (Boidin & Gilles 2002, Xavier de Lima et al. 2020). Cystidia are hyaline to brown and thick-walled. Basidia are clavate, and basidiospores are ellipsoid, CB- and IK- (Xavier de Lima et al. 2020).

Members of *Porostereum* are a potential source of metabolites that can be tapped for beneficial purposes (Sarkar & Datta 2024). *Porostereum umbrinoalutaceum* is reported as an endophyte in the basidiomata of *Pleurotus ostreatus*. Sarkar & Datta (2024) have indicated the potential of this fungus in the formulation of bio-fertilisers. This species tolerates toxic metals (Mg, Ca, Fe, Cu, Mn, Zn, Cd) and inhibits the growth of *Alternaria solani* Sorauer and *Penicillium citrinum* Thom in chilli plants (Sarkar & Datta 2024). Similarly, another endophytic fungus, *P. spadiceum*, modulates endogenous phytohormones of the seedling to normalise the growth of salt-affected plants (Hamayun et al. 2017). The volatile compound produced by this fungus, 3, 5-dichloro-4-methoxybenzaldehyde, exhibited antimicrobial activity against *Clavibacter michiganensis* subsp. *michiganensis*, *Ralstonia solanacearum*, *Alternaria brassicicola* (Schwein.) Wiltshire, and *Colletotrichum orbiculare* Damm, P.F. Cannon & Crous (Hamamoto et al. 2021, Sarkar & Datta 2024).

Type species: *Porostereum phellodendri* Pilát

Other accepted species:

P. sharpianum (A.L. Welden) Hjortstam & Ryvarden

P. spadiceum (Pers.) Hjortstam & Ryvarden

P. submembranaceum (Henn.) Ryvarden

P. subspadiceum Kezo, Kaliyap. & Gunas.

P. umbrinoalutaceum (Wakef.) Hjortstam & Ryvarden

Podoscyphaceae D.A. Reid, Beihefte zur Nova Hedwigia 18, 43

Species Fungorum, Facesoffungi, MycoBank, GenBank

Classification: *Polyporales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Podoscyphaceae was initially established by Reid (1965) to accommodate all the steroid and stipitate taxa and was typified by *Podoscypha* Pat. This family is well distributed from tropical to subtropical areas with few endemic taxa (Douanla-Meli & Langer 2004). Generally, the basidiomata grow on exposed or buried wood, typically are thin, leathery, infundibuliform, or spathulate in shape with a smooth to hairy surface (Zoberi 1972). Members of *Podoscyphaceae* are characterised by mono- or di- or trimitic hyphal systems, presence of cystidia and gloeocystidia, and smooth basidiospores (Douanla-Meli & Langer 2004). The gloeocystidia are often hyaline

structures but stain deeply in aniline blue (Zoberi 1972). *Podoscyphaceae* includes two genera: *Abortiporus* Murrill and *Podoscypha* (Hyde et al. 2024a).

Podoscypha Pat., Essai Taxonomique sur les Hyménomycètes (Lons-le-Saunier), 70

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 203

Classification: *Podoscyphaceae, Polyporales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Podoscypha was established as a new genus in 1900 under the series *Stereum* (Patouillard 1900). Presently, it is classified under *Podoscyphaceae* D.A. Reid as the type genus, with phylogenetic support (Si et al. 2023). It is well characterised with a variable form of basidiomata, including flabelliform to infundibuliform, stipitate, erect, or sessile, or leathery. Stipe is woody or cartilaginous, simple or branched (Patouillard 1900). Hymenophore is either smooth or rugose in texture (Si et al. 2023). Basidiospores are ellipsoidal to cylindrical, smooth, thin-walled, hyaline, acyanophilous, and show negative results with Melzer's reagent (inamyloid). Basidia are clavate-shaped (Patouillard 1900). Hymenium cystidia are hyaline, cylindrical, with an acute apex, and thin to slightly thick-walled (Si et al. 2023). The hyphal system is a dimitic type, with clamped generative hyphae. The species are either terrestrial or woody and are found mostly in tropical areas, including Asia, Europe, and North America, probably at higher altitudes (Patouillard 1900, Si et al. 2023).

The genus is typified by *Podoscypha nitidula* (Berk.) Pat., reported from Suriname, South America (Si et al. 2023). However, its morphological and molecular data are limited. *Podoscypha* can be differentiated from *Thelephora* Ehrh. ex Willd., another genus described under series *Stereum*, by its receptacle morphology, and from *Stereum* Hill ex Pers. for variably sized elements of the hymenial base (Patouillard 1900).

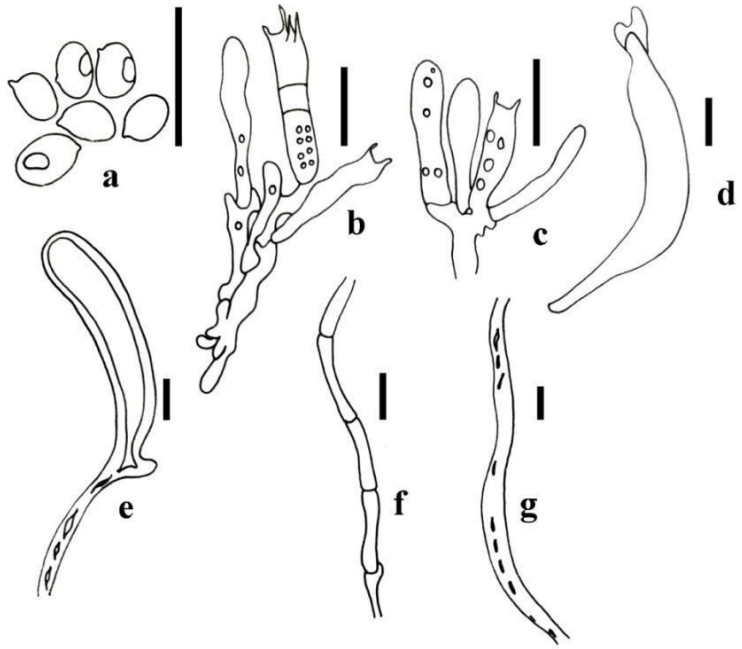


Fig. 203 – ***Podoscypha lactea***. a Basidiospores. b Basidia. c Basidioles and paraphyses. d Gleocystidia. e Pilocystidia. f Generative hyphae with clamp and simple septa. g Skeletal hyphae. Scale bars: a–g = 10 µm. Redrawn from Huang et al. (2024).

Molecular studies have been carried out for the genus using ITS, LSU, SSU, *tef-1α*, *rpb1*, and *rpb2* markers (Liu et al. 2023a, Si et al. 2023, Huang et al. 2024), suggesting that *Podoscypha* is phylogenetically closely related to *Cymatoderma* Jungh., and shares similarity for its dimitic hyphal

system, inamyloid basidiospores, and the presence of gloeocystidia, but the latter is differentiated by its large and robust basidiomata, hymenium with folds or ribbed-like structure, and the presence of clamp connections at the septa of the undifferentiated hyphae that form the tomentum (Huang et al. 2024). The classification of *Podoscypha* in *Podoscyphaceae, Polyporales, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* agrees in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a). Currently, Species Fungorum (2026) lists 49 species of *Podoscypha*. Because type material of the taxon has not been subjected to molecular phylogenetic analysis, a comprehensive multigene phylogeny is necessary to reconstruct its placement in a natural classification and to elucidate its evolutionary affinities with allied genera. (Si et al. 2023).

Synonym: *Stereogloeocystidium* Rick

Type species: *Podoscypha nitidula* (Berk.) Pat.

Basionym: *Stereum surinamense* Lév.

Other accepted species: (Species Fungorum – search *Podoscypha*)

Polyporaceae Fr. ex Corda, Icones Fungorum Hucusque Cognitorum (Prague) 3, 49

Species Fungorum, Facesoffungi, MycoBank, GenBank

Classification: *Polyporales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Polyporaceae is a diverse family of saprobic fungi characterised by soft, tough, often perennial basidiomata with a poroid hymenophore, mostly dimitic to trimitic hyphal system, presence of clamp connections, and thin- to thick-walled basidiospores (Fries 1838, Corda 1839, Cui et al. 2019). Although most members are poroid, some, such as *Daedaleopsis* J. Schröt., exhibit gill-like structures where the elongated pores form a corky, labyrinth-like surface. Fries (1838) in his work “Epicrisis Systematis Mycologici seu Synopsis Hymenomycetum” introduced this family as "Polyporei," and later, Corda (1839) validly published the name *Polyporaceae*. The type genus is *Polyporus* P. Micheli ex Adans., one of the earliest described poroid genera established by Micheli (1729) and later sanctioned by Fries (1838). The delimitation of genera and species within *Polyporaceae* is based on microscopic characters, including hyphal systems, basidia types, and context inclusions (Cunningham 1946). The taxonomic understanding of this family has evolved from morphology-based systems (Murrill 1903) to molecular phylogenetics, which revealed hidden diversity and led to reclassification of several genera (Justo et al. 2017, He et al. 2019). *Polyporaceae* contains 107 genera (Hyde et al. 2024a) and comprises both white-rot species that degrade lignin and brown-rot species that decompose cellulose and hemicellulose (Ryvarden & Johansen 1980).

Favolus Fr., Elenchus Fungorum (Greifswald) 1, 44

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 204

Classification: *Polyporaceae, Polyporales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Favolus was established by E.M. Fries in 1828, and the type species is *F. brasiliensis* (Murill 1905c). *Favolus*, a worldwide distributed monophyletic genus, is a wood-decaying genus containing fleshy basidomata (Sotome et al. 2013, Zhou & Cui 2017, Palacio et al. 2021a). Basidiomata of *Favolus* generally bear laterally stipitate and radially elongated pores. Another distinctive feature of this genus is a dimitic hyphal system (skeletal-binding hyphae) and thin-walled, smooth, cylindrical to navicular basidiospores (Sotome et al. 2013, Palacio et al. 2021a). *Favolus*, a white rot genus, generally occurs in dead fallen branches (Palacio et al. 2021a). Interestingly, *Favolus* have been reported as hosts for many mycophagous arthropods, adding ecological significance (Amaringo-Cortegano et al. 2013, Santa-Brígida et al. 2019, Falaschi et al. 2019, Palacio et al. 2021a). Some of its species are reported as wild edible mushrooms in Indonesia, Nepal, Papua New Guinea, and the Philippines (Boa 2004, Christensen et al. 2008, De Leon et al. 2013, Palacio et al. 2021a).

Initially, *Favolus* was placed in one of the six infrageneric morpho-groups under *Polyporus* (Ryvarden & Johansen 1980, Nunez & Ryvarden 1995, Ryvarden 2016, Palacio et al. 2021a). Further taxonomic studies, based on morphological (pilear surface) and phylogenetic data, show *Favolus* is split into two distinct clades, *Favolus s. s.* and *Neofavolus* (Sotome et al. 2013, Palacio et al. 2021a). Zhou and Cui (2017) used an eight-gene phylogeny (ITS, LSU, *tef1-α*, rrnS, *tbb1*, *rpb1*, and *rpb2*) to distinguish among species and identified four new species in the *Favolus* clade. Furthermore, Palacio et al. (2021a) used phylogenetic analyses of the combined genes ITS, LSU, and *rpb1* and four new species of *Favolus*. Within *Favolus*, Hyde et al. (2024a) recognise approximately 70 species worldwide. The classification of *Favolus* in *Polyporaceae, Polyporales, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* is in agreement in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Synonymy: *Poroauricula* McGinty, *Roseofavolus* T. Hatt.

Type species: *Favolus tenuiculus* P. Beauv.

Other accepted species: (Species Fungorum – search *Favolus*)

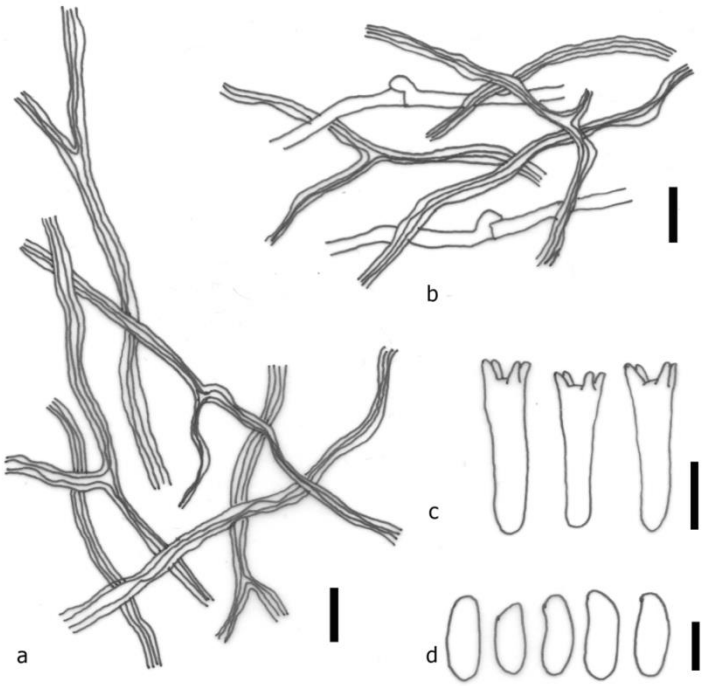


Fig. 204 – ***Favolus gracilisporus***. a Skeletal-binding hyphae in the context. b Clamped generative hyphae and skeletal-binding hyphae in the trama. c Basidia. d Basidiospores. Scale bar: a–c = 10 µm, d = 5 µm. Redrawn from Papp & Dima (2017).

Lignosus Lloyd ex Torrend, Brotéria, Série Botânica 18(2), 121

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 205

Classification: *Polyporaceae, Polyporales, Agaricomycetes, Agaricomycotina, Basidiomycota*, *Fungi*

Lignosus was initially coined by Lloyd but was validly published by Torrend in 1920, with *L. sacer* as the type species (Torrend 1920). Members of *Lignosus* are annual, single, terrestrial fungi that cause white-rot and are widely distributed in Africa (e.g., Cameroon, Kenya, and Zimbabwe), Asia (e.g., Indonesia, Malaysia, and South China), and parts of Europe (e.g., Germany) (Tan et al. 2013, Yap et al. 2015, Hu et al. 2017). Within *Lignosus*, Species Fungorum (2025) lists seven species worldwide. Phylogenetic analyses based on multiple gene regions (ITS, LSU, *rpb2*, and *atp6*) have consistently supported the placement of *Lignosus* within *Polyporales* (Sotome et al. 2008, Tan et al. 2010, Cui et al. 2011). Tan et al. (2013) described two new species, *L. tigris* and *L.*

cameronensis, based on morphological characteristics and phylogenetic analysis (ITS). The basidiomata of *Lignosus* are centrally stipitate and arise from subterranean sclerotia (Tan et al. 2013, Lau et al. 2015). The hyphal system is trimitic, with clamped generative hyphae (Ryvarden & Johansen 1980, Lau et al. 2015), and the basidiospores are hyaline, cylindrical to ellipsoid (Ryvarden & Johansen 1980, Lau et al. 2015).

Members of *Lignosus* are also recognised for their medicinal properties, particularly the sclerotia, which are widely used in traditional medicine in Southeast Asia and China. They are effective in treating various diseases such as breast cancer, coughs, asthma, and fever (Yap et al. 2013, Lau et al. 2015). In China, *L. rhinocerotis*, also known as *hurulingzhi*, is an edible and medicinal mushroom used to treat liver cancer, gastric ulcers, food poisoning, and chronic hepatitis (Lau et al. 2015, Hu et al. 2017). In Indonesia and Malaysia, *Lignosus* species are locally known as *susu rimau*, meaning "tiger's milk" or "tiger's breast" (Werner 2002, Lau et al. 2015). Notably, *L. rhinocerotis* has been successfully domesticated, and numerous studies have demonstrated its medicinal properties, including anti-inflammatory, antioxidative, antimicrobial, antiviral, anticancer, anticoagulant, and immunomodulatory activities (Abdullah et al. 2013, Lee et al. 2013, Hu et al. 2017).

The classification of *Lignosus* in *Polyporaceae, Polyporales, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* is in agreement in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Type species: *Lignosus sacer* (Afzel. ex Fr.) Torrend

Basionym: *Polyporus sacer* Afzel. ex Fr.

Other accepted species:

L. cameronensis Chon S. Tan
L. ekombitii Douanla-Meli
L. goetzei (Henn.) Ryvarden
L. hainanensis B.K. Cui
L. rhinoceros (Cooke) Ryvarden
L. tigris Chon S. Tan

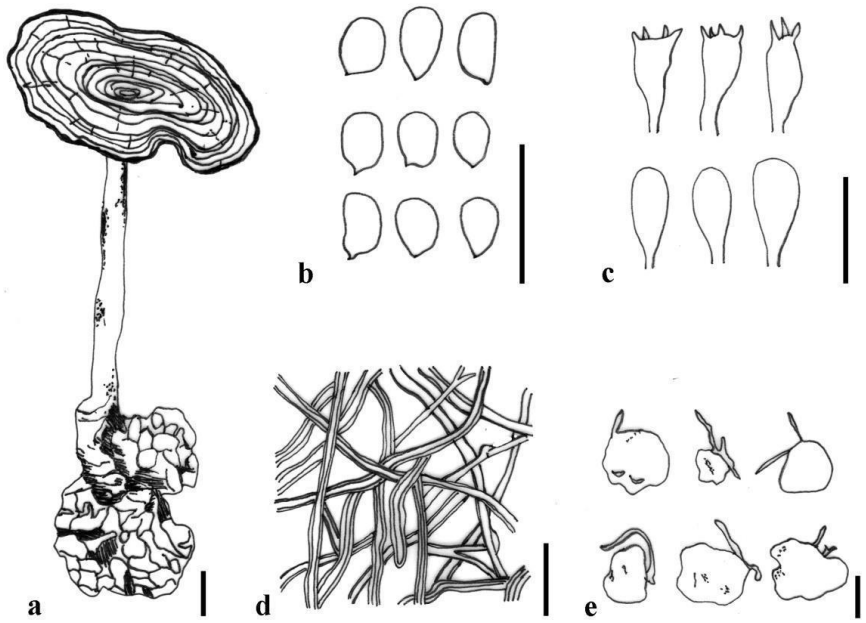


Fig. 205 – ***Lignosus tigris*** (holotype). a Basidiomata. b Basidiospores. c Basidia and basidioles. d Tramal hyphae. e Sclerids. Scale bar: a = 2 cm, b–c = 10 µm, d–e = 20 µm. Redrawn from Tan et al. (2013). For original basidiomata, refer to Lau et al. (2015).

Phaeotrametes McGinty ex J.E. Wright, Mycologia 58(4), 529

Species Fungorum, Facesoffungi, MycoBank Fig. 206

Classification: *Polyporaceae, Polyporales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Phaeotrametes was established by J.E. Wright in 1966 based on the description of its type species, *P. decipiens* (Wright 1966). The basidiomata are trametoid and are found abundantly on twigs of *Scutia buxifolia* in humid and shaded sites, mainly in Argentina, and their chlamydosporic basidiomata are reported in Uruguay (Lloyd 1915, Wright 1966). The genus is distributed mainly in the Southern Hemisphere, including Argentina, Uruguay, and Australia (Wright 1966). The classification of *Phaeotrametes* in *Polyporaceae, Polyporales, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* is in agreement in Species Fungorum, MycoBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Basidiomata of *Phaeotrametes* are dimidiate to resupinate, *Trametes*-like pileate region with slightly undulate, concentric light-coloured furrows, can be effused to reflexed, with a very inconspicuous and narrow sterile portion on the lower surface (Wright 1966). The pore surface is somewhat brownish-lilac away from the margin, with round to lacerate, sinuous or daedaloid pores and light to dark pinkish-brown or chestnut homomorphic context and a trimitic hyphal system. Basidiospores are usually yellowish-brown, inamyloid, and acyanophilous, with a 2–3-layered wall, narrowly ellipsoidal, with a distinct slit in the inner part of the wall at the distal pole, appearing truncate (Wright 1966).

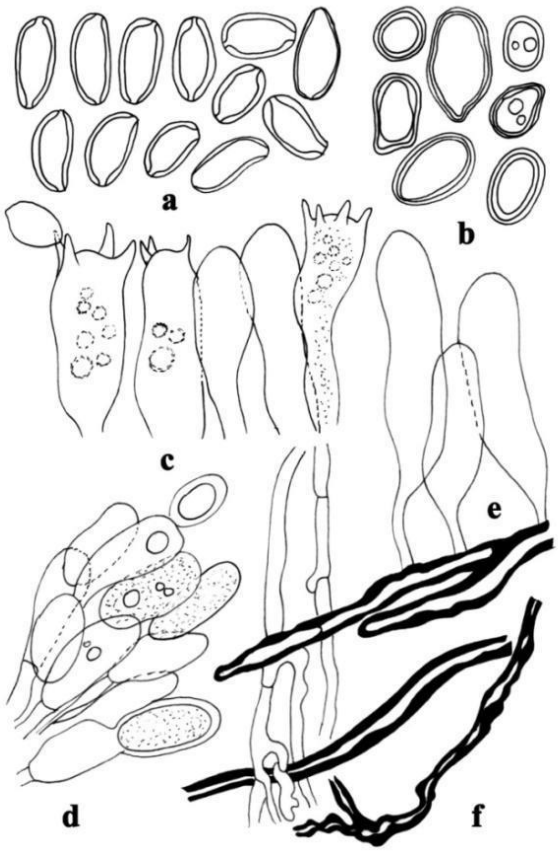


Fig. 206 – ***Phaeotrametes decipiens*** (Leg. Drummond, K, holotype). a Basidiospores. b Chlamydospores. c Hymenial palisade with basidia and basidioles. d Proliferation of chlamydospores formed by a succession of cells. e Basidial initials and skeletal hyphae. f Three types of hyphae. Scale bars: a–f = ×750. Redrawn from Wright (1966). For original basidiomata, refer to Wright (1966).

Phaeotrametes was also listed in Stevenson and Cash's 1936 compilation of fungal names

proposed by Wright (Wright 1966). However, Donk (1951) later clarified that these names were not validated according to the nomenclatural rules of the time (Article 37 bis). In 1960, Donk reiterated that *Phaeotrametes* was not validly published (Wright 1966). Other names, such as *Polystictus decipiens* (Schwein.) Fr. and *Trametes decipiens* Bres., were cited, but these were not considered synonymous with *Hexagonia decipiens* Berk. Then, in 1966, the genus was validated, as Lloyd had repeatedly stressed that materials labelled *Hexagonia* properly belonged to another genus, for which he provided a generic name (Wright 1966). The genus was described with only a single species, which to date appears to be monotypic (Hyde et al. 2024a). There is no recent study depicting the exact molecular phylogenetic position of the species.

Synonym: *Phaeotrametes* McGinty

Type species: *Phaeotrametes decipiens* (Berk.) J.E. Wright

Basionym: *Hexagonia decipiens* Berk.

Podofomes Pouzar, Česká Mykologie 20(3), 174

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 207

Classification: *Polyporaceae*, *Polyporales*, *Agaricomycetes*, *Agaricomycotina*, *Basidiomycota*, *Fungi*

Podofomes is a polyporoid genus belonging to *Polyporaceae* Fr. ex Corda in *Polyporales* Gäum, with *P. corrugis* (Fr.) Pouzarthe as the type species. The genus was established by Pouzar (1966) to accommodate *P. corrugis* (Fr.) Pouzar, which was initially described under *Polyporus* P. Micheli. Initially, this genus was considered monotypic (Pouzar 1966a), but subsequently, it increased to five species worldwide (Hyde et al. 2024a). The reclassification was based on distinct morphological and anatomical features that differentiated *Podofomes* from other genera within *Polyporaceae* (Pouzar 1966a). The species in this genus are primarily saprotrophic, growing on dead wood in temperate and subtropical forests, where they contribute to wood decomposition and nutrient cycling (Gilbertson & Ryvarden 1986). The classification of *Podofomes* in *Polyporaceae, Polyporales, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* is in agreement in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Podofomes is characterised by pileate basidiomata, with either a central or an eccentric stipe (Pouzar 1966a). The pileus surface is brown and separated from the true trama by a thin black layer. The pileus covering is bistratose, with the upper layer tomentose. The trama of the pileus is tough, corky, and fibrillose, while the stipe is tough and wood-brown in colour. The hyphal system is trimitic, with hyaline, thin-walled, and clamped generative hyphae and typically unbranched, straight, thick-walled to solid, aseptate skeletal hyphae. Their walls are brownish to yellowish brownish. Ligative hyphae have limited growth, are ramified with long branches arising from a short stem, and are either slightly brownish or hyaline. These are predominantly present in the stipe. All hyphae are inamyloid, indextrinoid, and acyanophilous. Basidia are clavate while basidiospores are thin-walled, hyaline, and smooth, with an inamyloid, indextrinoid, and acyanophilous membrane (Pouzar 1966a).

Over time, additional species have been assigned to the genus, though its circumscription remains subject to phylogenetic revisions. Early taxonomic studies recognised only *P. trogii* within *Podofomes*, but later molecular analyses supported the inclusion of other polyporoid fungi with similar growth habits and basidiospore characteristics (Ryvarden & Gilbertson 1993, Olou et al. 2023). Gorjón et al. (2020) conducted a phylogenetic study based on ITS analyses of *Podofomes trogii* (Fr.) Pouzar, which revealed its close relationship with *Datronia* Donk within *Polyporaceae*. They also proposed two new combinations in the genus, *Podofomes mollis* (Sommerf.) Gorjón and *P. stereoides* (Fr.) Gorjón.

Synonym: *Datronia* Donk

Type species: *Podofomes corrugis* (Fr.) Pouzar

Basionym: *Polyporus corrugis* Fr.

Other accepted species:

P. mollis (Sommerf.) Gorjón
P. pyrenaicus F. Rath
P. steroids (Fr.) Gorjón
P. trogii (Fr.) Pouzar

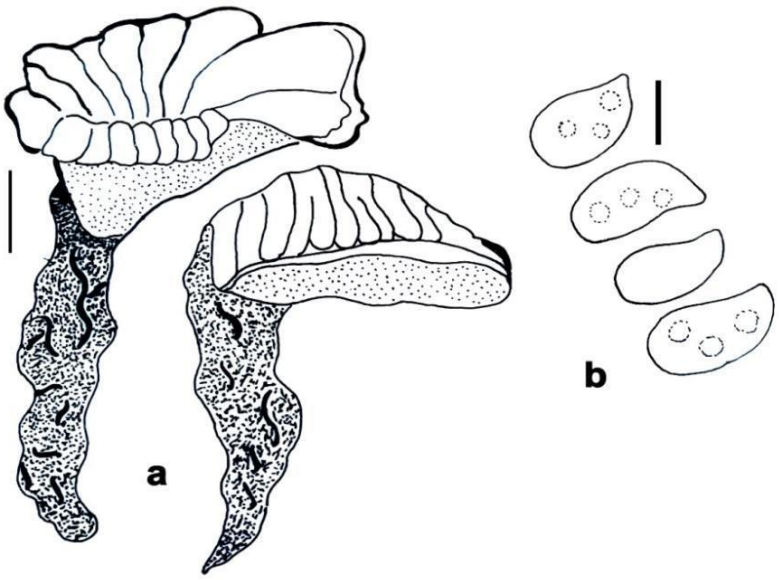


Fig. 207 – ***Podofomes corrugis***. a Basidiomata. b Basidiospores. Scale bars: a = 1 mm, b = 10 μm. Redrawn from Jahn (1974).

Polyporus P. Micheli ex Adans., Familles des Plantes 2, 10
Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 208
Classification: *Polyporaceae, Polyporales, Agaricomycetes, Agaricomycotina, Basidiomycota*, *Fungi*

Polyporus, a globally distributed genus (Gilbertson & Ryvarden 1987, Ryvarden & Gilbertson 1994, Núñez & Ryvarden 2001, Gomes-Silva et al. 2012, Dai et al. 2014, Xue & Zhou 2014), has been separated into smaller genera but is still considered as a 'mega-genus' causing white rot of wood (Vlasenko & Vlasenko 2015). Molecular studies consistently show *Polyporus* as a polyphyletic genus (Krüger et al. 2006, Sotome et al. 2008, Xue & Zhou 2014). *Polyporus* is divided into six well-supported, distinct clades, morphological groups without taxonomic rank: *Polyporus*, *Admirabilis*, *Dendropolyporus*, *Melanopus*, *Polyporellus*, and *Favolus* (Núñez & Ryvarden 1995, Sotome et al. 2008, Dai et al. 2014, Xue & Zhou 2014, Sotome et al. 2015). Combined molecular analysis of *rpb2* and LSU was used to establish a relationship between *Polyporus* and allied genera (Sotome et al. 2008). Later, Dai et al. (2014) used morphological and phylogenetic analysis (ITS and LSU) and discovered three new species of the group *Melanopus*. Ji et al. (2022) reconfirmed that *Polyporus* and its allied genera fell into six well-supported clades based on phylogenetic analysis of two combined datasets (ITS+LSU) and (ITS+LSU+*ef1-α*+SSU+*rpb1*+*rpb2*+*tub*). *Polyporus* is the type genus of *Polyporaceae* (Hyde et al. 2016).

Polyporus has a well-developed cap with a typical stipitate to substipitate basidiomata (Xue & Zhou 2013, Vlasenko & Vlasenko 2015). The hyphal system is dimitic, thick-walled with arboriform skeleto-binding hyphae (Núñez & Ryvarden 1995, Sotome et al. 2008, Gomes-Silva et al. 2012, Xue & Zhou 2013, Dai et al. 2014, Xue & Zhou 2014, Vlasenko & Vlasenko 2015). Basidiospores are hyaline, thin-walled, cylindrical to subellipsoid, smooth, and have a negative reaction in Melzer's reagent (Gilbertson & Ryvarden 1987, Núñez & Ryvarden 1995, Dai et al. 2014, Xue & Zhou 2014, Vlasenko & Vlasenko 2015). Hymenium does not bear cystidia (Gomes-Silva et al. 2012, Vlasenko & Vlasenko 2015). Some species, like *Polyporus tuberaster* and *P. umbellatus,* have been used for centuries as traditional medicine (Sotome et al. 2008, Vlasenko &

Vlasenko 2015, Pasailiuk 2020). Different ethnic groups in Central and South America consume *Polyporus tenuiculus* (Omarini et al. 2009). The classification of *Polyporus* in *Polyporaceae, Polyporales, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* is in agreement in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a). Hyde et al. (2024a) recognise approximately 250 species of *Polyporus*.

Synonymy: *Dendropolyporus* (Pouzar) Jülich, *Grandinioides* Banker, *Leucoporus* Quél., *Melanopus* Pat., *Mycelithe* Gasp., *Mycobonia* Pat., *Polyporus* subgen. *Dendropolyporus* Pouzar, *Poria* Adans.

Type species: *Polyporus tuberaster* (Jacq. ex Pers.) Fr.

Basionym: *Boletus tuberaster* Jacq. ex Pers.

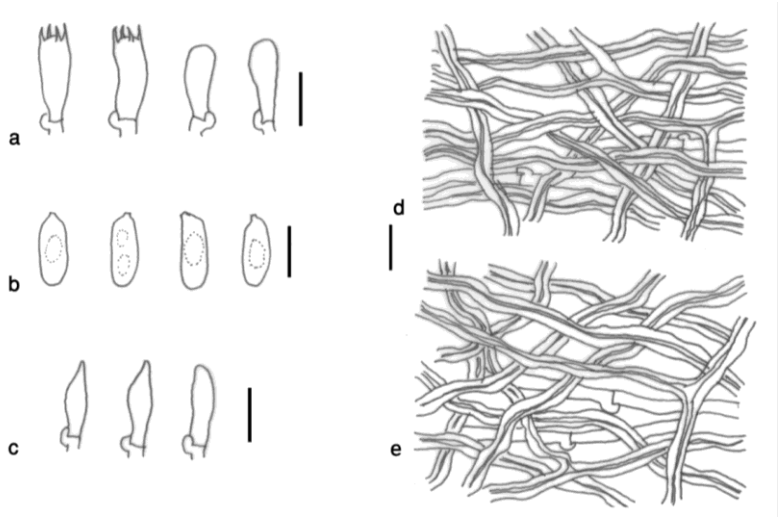


Fig. 208 – ***Polyporus americanus***. a Basidia and basidioles. b Basidiospores. c Cystidioles. d Hyphae from trama. e Hyphae from context. Scale bar: a = 5 µm, b−e =10 µm. Redrawn from Dai et al. (2014).

Pseudofavolus Pat., Essai Taxonomique sur les Hyménomycètes (Lons-le-Saunier), 80

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 209

Classification: *Polyporaceae, Polyporales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Pseudofavolus is a small, understudied genus of wood-decaying fungi in *Polyporaceae* Fr. ex Corda. It is primarily known from tropical and subtropical regions (Ryvarden & Johansen 1980, Ryvarden 2016). However, its taxonomic status has been a subject of debate for many years. The generic status of *Pseudofavolus* was rejected initially by Corner (1984) and Singer (1949), stating its relatedness to *Polyporus* P. Micheli. Another similar-looking genus, *Mycobonia* Pat. (=*Polyporus*) has been compared with *Pseudofavolus*.

Both *Pseudofavolus* and *Polyporus* possess subsessile, flabelliform to conchate basidiomata, dimitic hyphal systems, clamped generative hyphae, and large, smooth-walled basidiospores (Corner 1984). *Mycobonia,* along with *Pseudofavolus,* has often been treated as a synonym of *Polyporus* (Silveira & Wright 2002, Nakasone 2015). The affinities of these two genera with *Polyporus* have also been critically studied several times (Singer 1949, Corner 1984, Palacio et al. 2021b) alongside the phylogenetic analysis (Krüger 2002, Krüger & Gargas 2004, Motato-Vásquez et al. 2018). Molecular data placed *Pseudofavolus* distantly to *Polyporus sensu stricto* (Krueger & Gargas 2004, Motato-Vásquez et al. 2018), thus confirming its generic status in the core polyporoid clade.

Four species were described from the Neotropics: *P. cucullatus* (Mont.) Pat., *P. miquelii* (Mont.) Pat. (type species), *P. nigrus* Ryvarden, and *P. orinocensis* (Pat. and Gaillard) Ryvarden. However, the phylogenetic analyses by Palacio et al. (2021b) based on ITS, LSU, and *rpb2*

sequence data showed that *Pseudofavolus* represents an artificial group. The available sequences for *Pseudofavolus* species nested with *Mycobonia* species in the revised phylogeny (Palacio et al. 2021b). Following the priority of publication, *Pseudofavolus* has been proposed to be synonymised with *Mycobonia* (Palacio et al. 2021b).

The classification of *Pseudofavolus* in *Polyporaceae, Polyporales, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* is in agreement in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a). Currently, Species Fungorum (2026) lists seven species of *Pseudofavolus*.

Type species: *Pseudofavolus miquelii* (Mont.) Pat.

Basionym: *Polyporus miquielii* Mont.

Other accepted species:

P. bipindiensis (Henn.) Pat.
P. nigrus Ryvarden
P. orinocensis (Pat. & Gaillard) Ryvarden
P. polygrammus (Mont.) G. Cunn.
P. pulchellus (Lév.) G. Cunn.
P. tenuis (Fr.) G. Cunn.

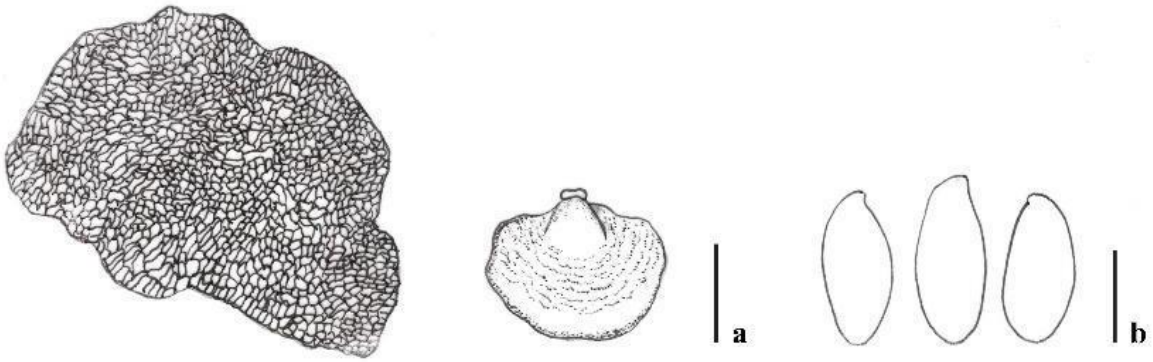


Fig. 209 – ***Pseudofavolus miquelii***. a Basidiomata. b Basidiospores. Scale bar: a = 1 cm, b = 10 μm. Redrawn from Palacio et al. (2021b). For original basidiomata, refer to https://www.inaturalist.org/observations/163098238. The photo has been used under the CC BY 4.0 International non-commercial license.

Postiaceae B.K. Cui, Shun Liu & Y.C. Dai, Fungal Diversity 118, 68

Species Fungorum, Facesoffungi, MycoBank, GenBank

Classification: *Polyporales*, *Agaricomycetes*, *Agaricomycotina*, *Basidiomycota*, *Fungi*

Postiaceae was erected by Liu et al. (2023a) to accommodate *Postia* Fr. as the type genus, based on morphological characters and multigene phylogeny based on ITS, LSU, SSU, *tef1*, *rpb1*, and *rpb2* sequence data. Members of this family have annual and poroid basidiomata, monomitic and clamped hyphal systems, and allantoid to ellipsoid basidiospores. Species cause brown rot. Phylogenetically, *Postia s.l.* form a well-supported monophyletic clade which is consistent with earlier studies (Pildain & Rajchenberg 2013, Justo et al. 2017, Shen et al. 2019). Currently, 16 genera are recognised within *Postiaceae* worldwide (Liu et al. 2023a).

Cyanosporus McGinty, Mycological Notes (Cincinnati) 33, 436

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 210

Classification: *Postiaceae*, *Polyporales*, *Agaricomycetes*, *Agaricomycotina*, *Basidiomycota*, *Fungi*

Cyanosporus was proposed by McGinty in 1909 to accommodate *Polyporus caesius* (Schrad.) Fr (later *Postia caesia* (Schrad.) P. Karst.) based on its characteristic cyanophilous spores;

however, it fell out of use until revived in molecular studies (McGinty 1909, Papp 2017, Shen et al. 2019). Comprehensive multigene phylogenetic analyses confirmed that *Cyanosporus* is an independent genus distinct from *Postia* Fr. (Liu et al. 2022b). Species of *Cyanosporus* are brown-rot decay fungi, with distinctive blue-tinted basidiomata that range from resupinate to effused-reflexed or pileate forms. They occur on both angiosperm and gymnosperm hosts and are distributed globally across Asia, Europe, North America, South America, and Oceania (Liu et al. 2022b, Wang et al. 2024).

The basidiomata of *Cyanosporus* are annual and vary from crust-like resupinate to effuse-reflexed or pileate, with a soft corky to fragile texture. The pileal surface often exhibits a distinctive bluish tint over a white, cream, or greyish-brown background, while the pore surface is typically white to cream, occasionally bluish, with round to angular pores. The hyphal system is monomitic, consisting of clamped generative hyphae that are non-amyloid and acyanophilous in iodine and cotton blue reactions. Cystidia are usually absent, though cystidioles may be present, which helps distinguish *Cyanosporus* from morphologically similar genera. The basidiospores are narrow, smooth, hyaline, allantoid to cylindrical, and thin- to slightly thick-walled, exhibiting weak to distinct cyanophily in some species (Liu et al. 2022b).

Multilocus phylogenetic analyses (ITS, LSU, SSU, *tef-1α*, *rpb1*, and *rpb2*) place *Cyanosporus* in the antrodia clade of *Polyporales*, separate from *Postia*. The genus is supported as monophyletic, containing approximately 31 recognised species worldwide after inclusion of five newly described taxa and fifteen new combinations (Shen et al. 2019, Liu et al. 2022b).

The classification of *Cyanosporus* in MycoBank, GenBank, He et al. (2024), and Hyde et al. (2024a) is under *Postiaceae*, whereas Species Fungorum and UNITE list it under *Polyporaceae* and *incertae sedis*, respectively and may need updating. Currently, Species Fungorum (2026) lists 39 species of *Cyanosporus*.

Type species: *Cyanosporus caesius* (Schrad.) McGinty

Basionym: *Boletus caesius* Schrad.

Other accepted species: (Species Fungorum – search *Cyanosporus*)

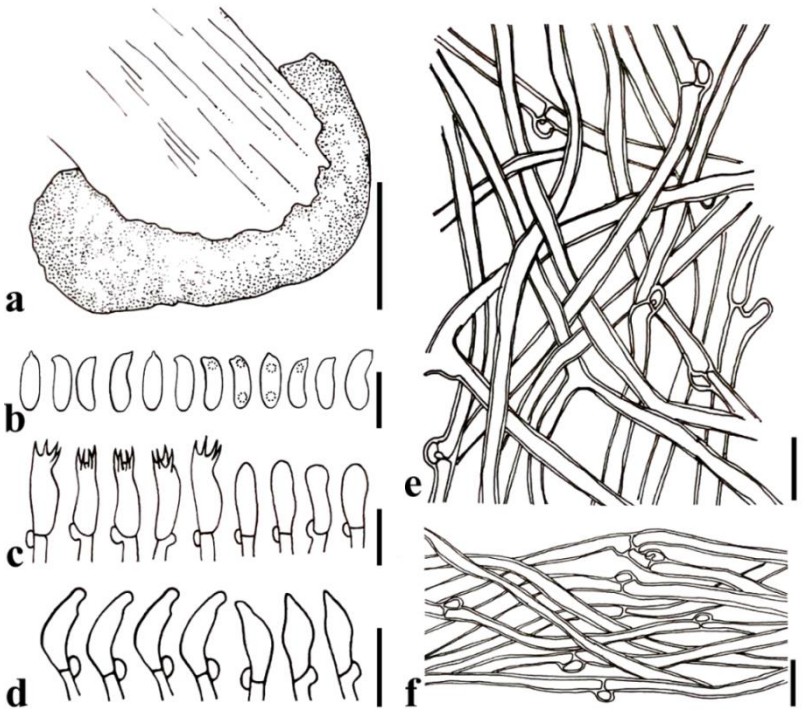


Fig. 210 – ***Cyanosporus tabuliformis***. a Basidiomata. b Basidiospores. c Basidia and basidioles. d Cystidioles. e Hyphae from context. f Hyphae from trama. Scale bars: a = 10 mm, b = 5 μm, c−f = 10 μm. Redrawn from Wang et al. (2024). For original basidiomata, refer to Wang et al. (2024).

Pycnoporellaceae Audet, Mushrooms nomenclatural novelties 16, 1

Species Fungorum, Facesoffungi, MycoBank, GenBank

Classification: *Polyporales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Pycnoporellaceae is a wood-inhabiting basidiomycete within *Polyporales* that was established by Audet (2018) to accommodate *Crustoderma* Parmasto and *Pycnoporellus* Murrill (type genus), showing close phylogenetic affinity but distinct from *Sparassidaceae* Jülich and related families. The previous studies showed that *Pycnoporellus* and *Crustoderma* clustered with *Sparassis* Fr., but with weak support (Justo et al. 2017, Audet 2018). Phylogenetically, multigene analyses (LSU, *rpb1*, and *rpb2*) consistently recovered *Pycnoporellus* separate from *Sparassis*, but clustering with *Crustoderma* (Ortiz-Santana et al. 2013, Han et al. 2016, Audet 2018). Bayesian analyses by Audet (2018) provided strong support for the recognition of *Pycnoporellaceae* as a separate family. This family is characterised by resupinate to effused-reflexed, rarely sessile basidiomata, often yellowish to orange, grey or olive coloured. Hymenophore is smooth or poroid or sometimes with scattered warts (Audet 2018). Hyphal system is monomitic with rarely clamped, thin- to thick-walled hyphae. Cylindrical to clavate cystidia are present. Basidiospores are smooth, subglobose to ellipsoidal, or cylindrical and binucleated. The members cause brown-rot.

Crustoderma Parmasto, Conspectus Systematis Corticiacearum (Tartu), 87

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 211

Classification: *Pycnoporellaceae, Polyporales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Crustoderma was established by Parmasto (1968) in *Corticiaceae* Herter to accommodate *C. dryinum* as its type species (Berk. & M.A. Curtis) Parmasto. Nakasone (1984) amended the genus to include information on cultural characters, associated brown-rot decay, and the slightly thick-walled basidiospores. Later, it was classified under *Sparassidaceae* Herter (He et al. 2019), and is currently classified under *Pycnoporellaceae* Audet in 2018, supported phylogenetically (Liu et al. 2023a). The classification of *Crustoderma* in MycoBank, He et al. (2024), and Hyde et al. (2024a) is under *Pycnoporellaceae*, whereas Species Fungorum and UNITE list it under *Sparassidaceae* and may need updating. Currently, Species Fungorum (2026) lists 19 species of *Crustoderma*.

Crustoderma is characterised by resupinate, effused, ceraceous to crustaceous basidiomata that are closely attached to the substrate with abrupt margins (Nakasone 1984, Pérez Gorjón 2020, Liu et al. 2023a). Subiculum is yellow and ochraceous to cinnamon brown (Liu et al. 2023a). Basidiospores are subglobose, cylindrical to ellipsoid, smooth, colourless or yellow, thin- to slightly thick-walled, IKI–, usually stained in CB. The hyphal system is monomitic, with slightly thick-walled, yellow hyphae and clamp-connected generative hyphae (Pérez Gorjón 2020, Liu et al. 2023a). Cystidia or cystidioles are absent (Liu et al. 2023a). Members are known to cause brown rot. The genus is widely distributed across Asia, Europe, and North America, inhabiting coniferous and hardwood trees as host-substrate (Ortiz-Santana et al. 2013). *Crustoderma* species play a role in bioremediation, including the degradation of treated wood and wastewater (Ortiz-Santana et al. 2013).

Various phylogenetic studies conducted based on a combination of ITS, LSU, SSU, *rpb1*, and *tef-1α* suggest *Crustoderma* is closely related to *Pycnoporellus* Murill in the same family, *Pycnoporellaceae* (Justo et al. 2017, Liu et al. 2023a). Both genera share similarities in resupinate basidiomata, cylindrical to ellipsoidal basidiospores, monomitic hyphal system; however, *Crustoderma* is differentiated by its smooth hymenophore (vs poroid in *Pycnoporellus*), absence of cystidia and cytidioles (cystidia present in *Pycnoporellus*), clamped generative hyphae (simple septate in *Pycnoporellus*), bipolar mating system (homothallic in *Pycnoporellus*), and astatocoenocytic nuclear behaviour (holocenocytic in *Pycnoporellus*) (Ortiz-Santana et al. 2013, Liu et al. 2023a).

Type species: *Crustoderma dryinum* (Berk. & M.A. Curtis) Parmasto

Basionym: *Corticium dryinum* Berk. & M.A. Curtis

Other accepted species: (Species Fungorum – search *Crustoderma*)

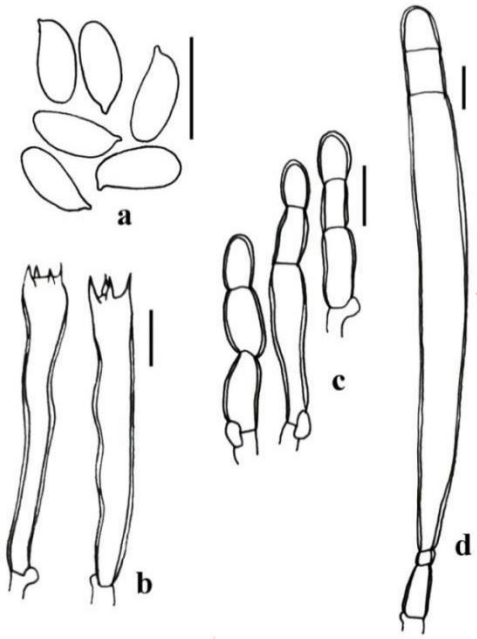


Fig. 211 – ***Crustoderma dryinum***. a Basidiospores. b Basidia. c Cystidioles. d Cystidium. Scale bars: a–d = 10 µm. Redrawn from Nakasone (1984).

Steccherinaceae Parmasto, Conspectus Systematis Corticiacearum (Tartu), 169

Species Fungorum, Facesoffungi, MycoBank, GenBank

Classification: *Polyporales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Steccherinaceae was circumscribed by Parmasto (1968) to include genera with a hydnoid or poroid hymenium, dimitic hyphal system, clamp connections in generative hyphae, and frequent presence of cystidia (Maas Geesteranus 1971, Westphalen et al. 2021). The family is typified by *Steccherinum* Gray. Later, with the introduction of molecular studies, the limits of *Steccherinaceae* were redefined. Miettinen et al. (2012), with their multigene phylogenetic analysis, proposed the monophyly of the *Steccherinum* clade and included other genera with monomitic hyphal systems and simple septate generative hyphae. In a reassessment of order *Polyporales* Gäum., Justo et al. (2017) confirmed the monophyly of *Steccherinaceae* nesting in the residual polyporoid clade. Currently, *Steccherinaceae* includes 23 genera (Hyde et al. 2024a).

Atraporiella Ryvarden, Synopsis Fungorum (Oslo) 23, 38

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 212

Classification: *Steccherinaceae, Polyporales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Atraporiella was proposed by Ryvarden (2007), designating *A. neotropica* as the type species (Ryvarden 2007). This genus is characterised by annual, resupinate basidiomata that are easily separable from the substrate. When fresh, these basidiomata have a slightly waxy texture but become brittle upon drying. The monomitic hyphal system consists of generative hyphae with clamp connections. The basidiospores are allantoid to ellipsoid in shape, and all structural elements in the fungus are acyanophilous and negative in Melzer's reagent, indicating the absence of amyloid or dextrinoid reactions (Ryvarden 2007).

Wu et al. (2017c) expanded the genus by describing a new species, *Atraporiella yunnanensis*, which was supported by both morphological observations and molecular phylogenetic analysis. The molecular phylogenetic analysis conducted by Wu et al. (2017c) positioned *Atraporiella* within a residual polyporoid clade, alongside related genera such as *Antrodiella* Ryvarden & I. Johans., *Ceriporiopsis* Domański, *Junghuhnia* Corda, and *Steccherinum* Gray. This analysis demonstrated that *Atraporiella* is phylogenetically distinct from other resupinate polypores, reinforcing its status

as a separate genus (Wu et al. 2017c). Two species are recognised, *A. neotropica* and *A. yunnanensis* (Ryvarden 2007, Wu et al. 2017c). The known distribution of these species spans tropical regions in Belize and subtropical areas in China. *Atraporiella* species typically colonise fallen angiosperm wood logs, making them common in environments with decomposing wood (Wu et al. 2017c). Molecular data for *Atraporiella* includes sequences of multiple genes, such as the ITS, SSU, LSU, *rpb2*, and *tef* (NCBI 2025). This combination of morphological and molecular evidence helps delineate *Atraporiella* as a distinct genus within the polyporoid fungi, highlighting its unique characteristics and evolutionary relationships (Ryvarden 2007, Wu et al. 2017c).

The classification of *Atraporiella* in *Steccherinaceae, Polyporales, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* agrees in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Type species: *Atraporiella neotropica* Ryvarden

Other accepted species: *A. yunnanensis* C.L. Zhao

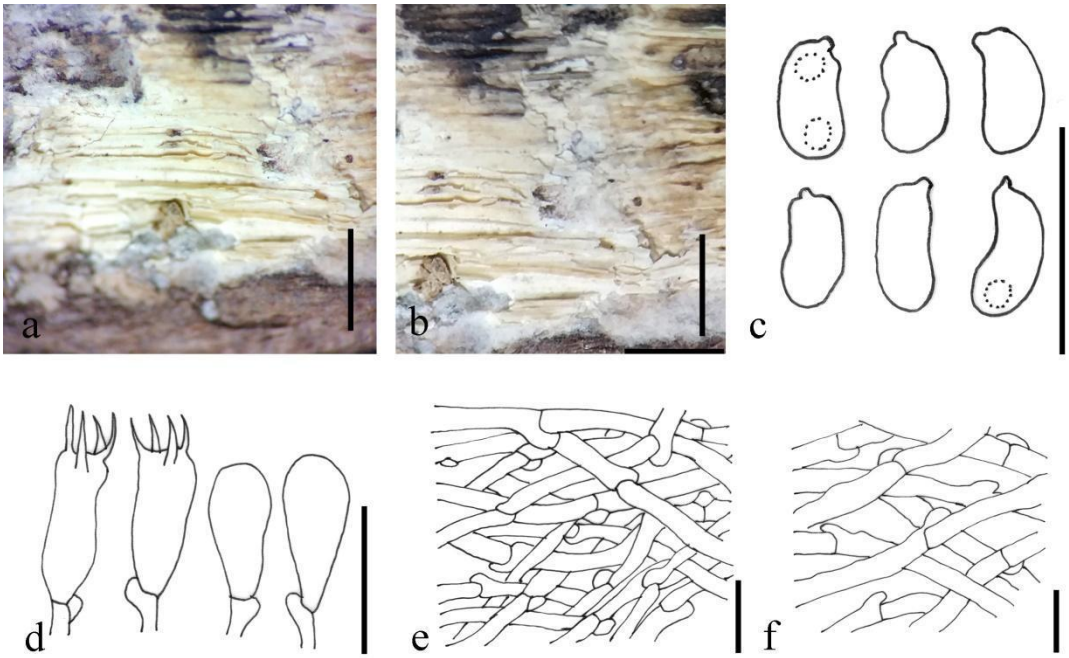


Fig. 212 – ***Atraporiella yunnanensis*** (SWFC Zhao 605, holotype). a, b Basidiomata. c Basidiospores. d Basidia and basidioles. e Hyphae from trama. f Hyphae from subiculum. Scale bars: a–b = 3 mm, c = 5 µm, d–f = 10 µm. Redrawn from Wu et al. (2017c). For original basidiomata, refer to Wu et al. (2017c).

Flaviporus Murrill, Bulletin of the Torrey Botanical Club 32(7), 360

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 213

Classification: *Steccherinaceae*, *Polyporales*, *Agaricomycetes*, *Agaricomycotina*, *Basidiomycota*, *Fungi*

Flaviporus was introduced by Murrill in 1905, with *F. rufoflavus* (Berk. & M.A. Curtis) Murrill designated as the type species (Murrill 1905b). The genus was segregated from other polyporales based on its characteristic yellow-hued, small and thin basidiomata with minute pores and dimitic, agglutinated hyphae (Ginns 1980, Miettinen et al. 2012, Westphalen et al. 2022). Species of *Flaviporus* are wood-decaying white-rot polypores, with notable diversity in tropical and neotropical regions (Ginns 1980, Westphalen et al. 2022).

The basidiomata of *Flaviporus* are annual, small, and thin, typically taking on a dimidiate to fan-shaped or effused-reflexed form. When fresh, the context is soft and watery, but it becomes hard, resinous, or woody upon drying. The pore surface features minute pores (approximately 6–20 per mm) and displays a colour range from yellow to cream or pinkish hues. The hyphal system is

dimitic, comprising glabrous generative hyphae with clamp connections and thick-walled skeletal hyphae. The basidiospores are broadly ellipsoid to subglobose, hyaline, smooth, and thin-walled. Tramal cystidia are present in some species, such as *F. brownii* (Humb.) Donk and *F. liebmannii* (Fr.) Ginns, where they may project beyond the hymenium, though they are not consistently observed across the genus (Westphalen et al. 2022, Wei et al. 2023b).

The classification of *Flaviporus* within *Steccherinaceae*, *Polyporales*, *Agaricomycetes*, *Agaricomycotina*, and *Basidiomycota* is in agreement with Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi (Hyde et al. 2024a). Currently, Species Fungorum (2026) lists 13 species of *Flaviporus*.

A recent multigene phylogenetic study (ITS, LSU, *tef1-α*, and *rpb1*) places *Flaviporus* firmly within *Steccherinaceae* (*Polyporales*). Analyses in neotropical taxa reveal that *F. liebmannii* represents a species complex with at least two cryptic lineages, including *F. subglobisporus* (Ginns) Westph. & Motato-Vásq. Morphological traits such as small yellow basidiomata and minute pores have limited taxonomic resolution, leading to persistent misidentifications (Westphalen et al. 2022, Wei et al. 2023b). Newly described taxa like *F. lacteus* Westph. & R.M. Silveira further illustrates unresolved diversity within the genus (Westphalen et al. 2022, Wei et al. 2023b).

Synonymy: *Baeostratoporus* Bondartsev & Singer

Type species: *Flaviporus rufoflavus* (Berk. & M.A. Curtis) Murrill

Basionym: *Polyporus rufoflabus* Berk. & M.A. Curtis

Other accepted species: (Species Fungorum – search *Flaviporus*)

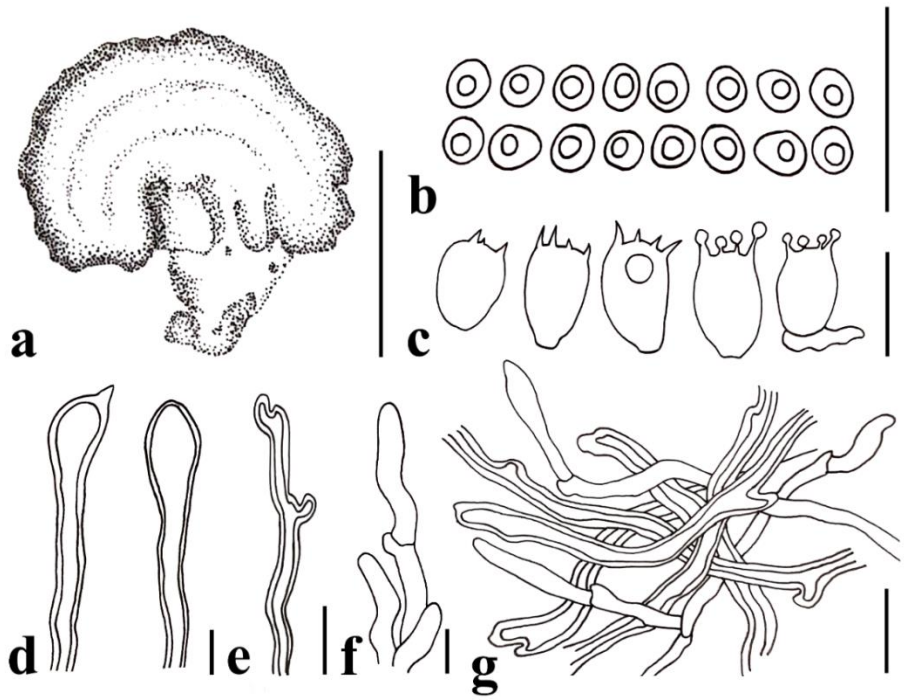


Fig. 213 – ***Flaviporus albus***. a Basidiomata. b Basidiospores. c Basidia. d Skeletocystidia. e–f Clamp connection and branch of generative hyphae. g Detail of the trama hyphae. Scale bars: a = 1 cm, b–e = 10 μm. Redrawn from Wei et al. (2023b). For original basidiomata, refer to Wei et al. (2023b).

Polyporales genera incertae sedis

Erythromyces Hjortstam & Ryvarden, in Hjortstam & Tellería, Mycotaxon 37, 55

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 214

Classification: *Incertae sedis, Polyporales, Agaricomycetes, Agaricomycotina, Basidiomycota*, *Fungi*

The monotypic genus, *Erythromyces*, was established by Hjortstam and Telleria to accommodate *E. crocicreas* as its type species (Hjortstam & Telleria 1990). *Erythromyces* have been reported in tropical areas of China (Qin et al. 2009). The classification of *Erythromyces* in Hyde et al. (2024a) is under *incertae sedis*, whereas Species Fungorum, MycoBank, and GenBank list it under *Hymenochaetaceae* and may need updating.

The basidiomata of *Erythromyces* are characterised by annual, resupinate, and closely attached to woody substrate (Qin et al. 2009). They are distinctly marked by red zones where they attach to the substrate. The hymenophore ranges in colour from greyish-brown to cinnamon brown or dark brown, featuring a smooth texture and a dense layer of hair-like structures, with prominent cystidia visible under magnification. When dry, the hymenophore exhibits cracks, and its margin appears indeterminate. The subiculum is woody-hard and reddish-brown (Qin et al. 2009).

The hyphal system is dimitic, comprising generative hyphae with clamp connections and dominant skeletal hyphae that are non-reactive in iodine and cotton blue. The generative hyphae are hyaline, thin-walled, and unbranched, while the skeletal hyphae vary from hyaline to yellow-brown, with thick-walled ones that may be nearly solid and sometimes slightly encrusted, primarily arranged in a vertical orientation. Cystidia are abundant, characterised by an acute shape, strong encrustations, thick walls, and a yellowish-brown to reddish colouration when treated with potassium hydroxide. The basidia are clavate with a basal clamp connection and four sterigmata, arranged in a dense palisade and often somewhat stalked. Basidioles are similar to basidia, but slightly smaller. The basidiospores are cylindrical to ellipsoid, hyaline, thin-walled, smooth, and taper toward the apiculus (Qin et al. 2009).

Based on phylogenetic analysis (ITS), *E. crocicreas* has a close relationship with *Tinctoporellus* (Yuan & Wan 2012). Additionally, *E. crocicreas* is known to discolour wood to a reddish hue and exhibits ecological traits similar to those of *Tinctoporellus* (Yuan & Wan 2012). However, *E. crocicreas* is distinct from *Tinctoporellus* by its monomitic hyphal system and presence of numerous thick-walled, strongly encrusted, and protruding cystidia (Hjortstam & Telleria 1990, Yuan & Wan 2012).

Type species: *Erythromyces crocicreas* (Berk. & Broome) Hjortstam & Ryvarden

Basionym: *Hymenochaete crocicreas* Berk. & Broome

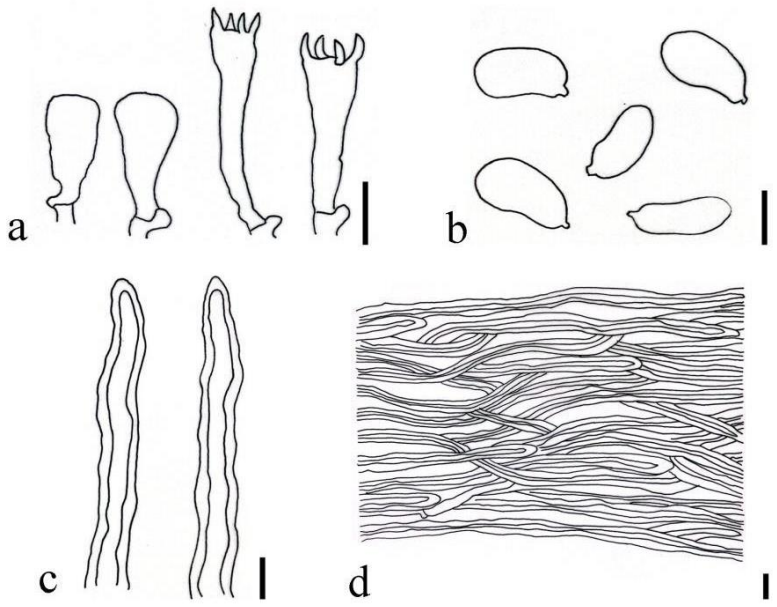


Fig. 214 – ***Erythromyces crocicreas*** (Dai 4525). a Basidia and basidioles. b Basidiospores. c Skeletocystidia. d Hyphae from subiculum. Scale bar: a = 5 μm, b–d = 10 μm. Redrawn from Qin et al. (2009).

Russulales Kreisel ex P.M. Kirk, P.F. Cannon & J.C. David, in Kirk, Cannon, David & Stalpers, Ainsworth & Bisby's Dictionary of the Fungi, Edition 9 (Wallingford), xi

Species Fungorum, Facesoffungi, MycoBank, GenBank

Bondarzewiaceae Kotl. & Pouzar, Česká Mykologie 11(3), 163

Species Fungorum, Facesoffungi, MycoBank, GenBank

Classification: *Russulales, Agaricomycetes, Agaricomycotina, Basidiomycota*, *Fungi*

Bondarzewiaceae was originally established to include all wood-rotting taxa and was typified with *Bondarzewia* Singer (Kotlaba & Pouzar 1957). Initially, the family included three genera: *Amylaria* Corner, *Bondarzewia*, and *Hericium* Pers. and was characterised by fleshy basidiomata with poroid, hydnoid, or clavarioid hymenium, annual growth habit, and amyloid basidiospores (Kotlaba & Pouzar 1957). Stalpers (1979) and He et al. (2024) added other characters such as resupinate, effuse-reflexed, pileate-sessile, pileate-stipitate to clavarioid basidiomata, pseudodimitic to dimitic hyphal system, presence of clamp connections, presence of thick-walled encrusted cystidia, gloeoplerous hyphae, and gloeocystidia may be present, and asperulate to spinulose, verrucose to echinulate, hyaline to pigmented basidiospores. Currently, the family is composed of nine genera: *Amylaria* Corner, *Amylosporus* Ryvarden, *Bondarzewia* Singer, *Gloiodon* P. Karst., *Heterobasidion* Bref., *Laurilia* Pouzar, *Lauriliella* Nakasone & S.H. He, *Steccherici*um D.A. Reid, and *Wrightoporia* Pouzar (He et al. 2024, Hussain et al. 2024, Hyde et al. 2024a). The members of *Bondarzewiaceae* are widely distributed in tropical, subtropical, and temperate regions (He et al. 2024).

Amylaria Corner, Bulletin of the British Museum (Natural History), Botany 1(7), 197

Species Fungorum, Facesoffungi, MycoBank Fig. 215

Classification: *Bondarzewiaceae, Russulales, Agaricomycetes, Agaricomycotina, Basidiomycota*, *Fungi*

Amylaria is a monotypic clavorioid genus introduced by Corner in 1955, designating *A. himalayensis* as its type species (Kirk et al. 2008). The taxon is known only from Bhutan and Nepal, where it was observed on the forest floor at elevations of approximately 2800 m in Nepal and 3000 m in Bhutan. It typically grows among moss or on rotting buried wood at the base of conifer trees (Balfour-Browne 1955, Kirk et al. 2008).

Amylaria is mainly characterised by the presence of erect, flattened, branched, and somewhat leathery basidiomata, which grow either on the ground or on decaying wood. The basidiospores are white, amyloid, broadly ellipsoidal, and possess a slightly thickened wall and a single guttule. The species lacks cystidia and features a slightly dimitic hyphal system, comprising two types of hyphae; one type is septate with clamp connections, thin-walled, and weakly inflated, while the other is thick-walled, non-septate, and sparsely branched. These hyphae are arranged either longitudinally or interwoven, often containing numerous elongated intercalary cells (Balfour-Browne 1955).

Recent systematics studies have placed *Amylaria* within *Bondarzewiaceae* (He et al. 2024, Hussain et al. 2024). This genus shares similarities with *Hericium* Pers. due to the presence of uniform amyloid basidiospores, a feature unique among clavarioid fungi (Balfour-Browne 1955). However, while *Hericium* exhibits spines as positively geotropic branchlets of a clavarioid basidiomata, *Amylaria* is characterised by erect, flabellately branched basidiomata (Balfour-Browne 1955). The imperfectly dimitic hyphal structure of *A. himalayensis* resembles that of *Pterula* Fr., with long, thick-walled hyphae acting as binding elements. This structural arrangement produces a felted and subcoriaceous tissue, distinct from the strictly longitudinal hyphae typically found in other pteruloid genera. Interestingly, *A. himalayensis* basidiomata can develop from a resupinate, yet fertile, *Corticium*-like patch. The basidiospores of *Amylaria* show similarities to those of *Polyporus berkeleyi* Fr. and *P. montanus* (Quél.) Ferry, which Singer placed in *Bondarzewia* Singer. This suggests a shared echinulate feature in *Amylaria*. Both *Amylaria* and

Bondarzewia lack gloeocystidia, a feature common in *Hericium*, further underscoring their structural resemblance (Balfour-Browne 1955).

No molecular sequence data are available, and the genus has not been re-examined or reported since its original protologue (Balfour-Browne 1955). As a result, the systematic placement of *Amylaria* within *Bondarzewiaceae* Kotl. & Pouzar remains a suspect (Balfour-Browne 1955). Future taxonomic studies require detailed morphological analysis and molecular identification to clarify the position of this genus. The classification of *Amylaria* in *Bondarzewiaceae, Russulales, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* agrees in Species Fungorum, MycoBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Type species: *Amylaria himalayensis* Corner

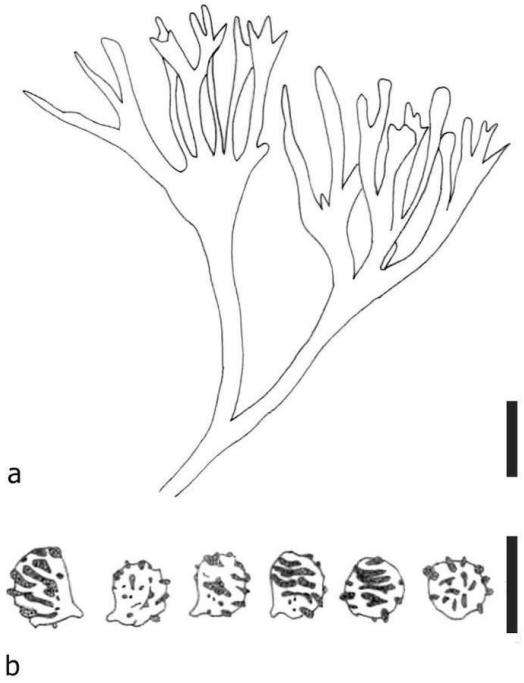


Fig. 215 – ***Amylaria himalayensis***. a Branch of a basidiomata. b Basidiospores. Scale bars: a–b = 10 µm. Redrawn from Balfour-Browne (1955).

Heterobasidion Bref., Untersuchungen aus dem Gesammtgebiete der Mykologie 8, 154

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 216

Classification: *Bondarzewiaceae, Russulales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Heterobasidion was introduced by Otto Brefeld in 1888, with *H. annosum* as the type species, which was originally described as *Polyporus annosus* by Elias Magnus Fries in 1821 (Brefeld 1888, Fries 1821). This genus has significant ecological and economic importance as a major pathogen affecting coniferous trees (Garbelotto & Gonthier 2013). The *H. annosum* species complex, referred to as *"H. annosum sensu lato*", is responsible for root and butt rot in forests, leading to substantial economic losses in timber production (Garbelotto & Gonthier 2013). *Heterobasidion annosum s.l.* is widely distributed across coniferous forests in the Northern Hemisphere, particularly in Europe, North America, China, Japan, and Russia (Dai et al. 2003, Dai et al. 2006, Otrosina & Garbelotto 2010, Worrall et al. 2010). In Europe alone, financial losses caused by *H. annosum* s.l. are estimated at €790 million annually (Garbelotto & Gonthier 2013). The fungus primarily infects trees through airborne spores that colonise freshly cut stumps or wounds, and spread to neighbouring trees through root contact, making it a persistent problem in managed forests (Garbelotto & Gonthier 2013).

Heterobasidion species play a dual role in forest ecosystems, aiding in nutrient cycling and influencing forest succession. However, in managed forests, it can disrupt ecosystem balance by causing tree mortality and reducing productivity. Their ability to switch between saprotrophic and necrotrophic lifestyles makes management challenging, as the species can persist in dead wood and stumps for decades, acting as a long-term source of infection (Garbelotto & Gonthier 2013).

Heterobasidion species are characterised by resupinate to effused-reflexed basidiomata, with a dimitic hyphal system without clamp connections, and small, smooth, hyaline basidiospores (Niemelä & Korhonen 1998, Garbelotto & Gonthier 2013). In culture, they produce white to cream-coloured mycelium that may darken with age. A notable feature of this genus is sectoring, where distinct growth regions with varying morphologies emerge. Some species also produce conidia (asexual spores) in culture, although these are rarely observed in nature (Niemelä & Korhonen 1998, Garbelotto & Gonthier 2013).

Heterobasidion species can be accurately identified using the ITS gene (Niemelä & Korhonen 1998, Garbelotto & Gonthier 2013). However, when ITS sequences lack sufficient resolution, additional gene regions such as SSU, *tef1-α*, and *rpb2* are used (Dalman et al. 2010). Within the *Heterobasidion annosum s.l.* complex, the closest species are *Heterobasidion annosum sensu stricto* and *H. irregulare*, which share a common ancestor but differ in host preferences, geographic distribution, and pathogenicity (Garbelotto & Gonthier 2013, Gonthier et al. 2007). The classification of *Heterobasidion* in *Bondarzewiaceae, Russulales, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* agrees in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a). Currently, Species Fungorum (2026) lists 18 species of *Heterobasidion*.

Synonymy: *Spiniger* Stalpers.; *Spongioides* Lázaro Ibiza.

Type species: *Heterobasidion annosum* (Fr.) Bref.

Basiomym: *Polyporus annosus* Fr.

Other accepted species: (Species Fungorum – search *Heterobasidion*)

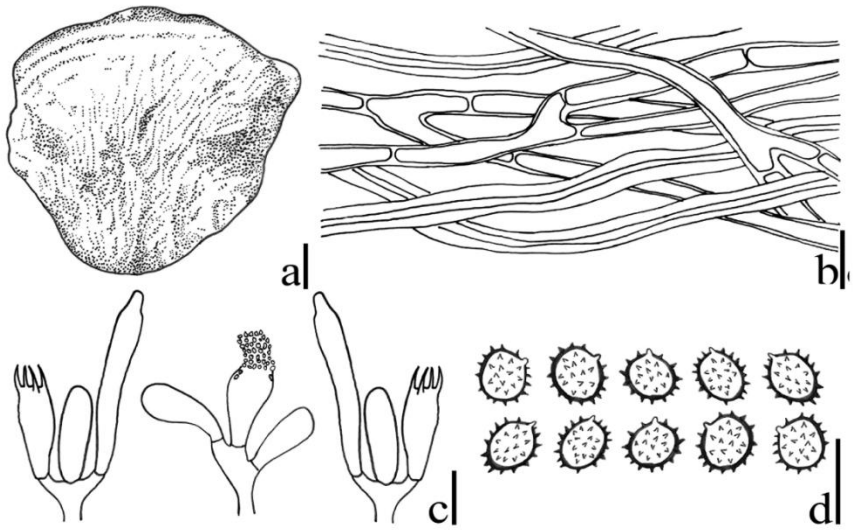


Fig. 216 – ***Heterobasidion amyloideum***. a Basidiomata. b Hyphae from context. c Basidia. d Basidiospores. Scale bars: a = 5 cm, b–d = 10 µm. Redrawn from Chen et al. (2013). For original basidiomata, refer to Chen et al. (2013). Drawings by Didsanutda Gonkhom.

Laurilia Pouzar, Česká Mykologie 13(1), 14

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 217

Classification: *Bondarzewiaceae, Russulales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Laurilia, a monotypic genus, is a crust fungus originally described in *Echinodontiaceae*

Donk, which has now been placed in *Bondarzewiaceae* Kotl. & Pouzar (Pouzar 1959, Wijayawardene et al. 2022, Hyde et al. 2024a). The genus was described in 1959 by Czech mycologist Zdeněk Pouzar, with *Laurilia sulcata* as the type species (Pouzar 1959, Ryvarden 2010). Members belonging to this genus grow on rotten wood of coniferous trees, on fallen logs of *Picea abies*, and are also found in poorer, drier communities or in rather wet ones with patches of *Sphagnum* and *Equisetum* (Eriksson & Ryvarden 1976). It has worldwide distribution, including Canada, Finland, Norway, Sweden, the United States, and some parts of Asia. Its European distribution is considered bicentric, with one population in northwestern Sweden and southeastern Norway, and another in northern Sweden and northern Finland. (Eriksson & Ryvarden 1976, Chamuris 1988, Ryvarden 2010). The classification of *Laurilia* in *Bondarzewiaceae, Russulales, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* agrees in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Laurilia is characterised by perennial, leathery or ligneous, resupinate, effused and confluent, or partly pileate basidiomata. The upper side of young specimens consists of a brown, tinder-like layer, which turns black and hard when older (Pouzar 1959, Ryvarden 2010). The trama consists of two layers: an upper tinder-like layer and a subiculum. The two layers are separated by a thin, hard, resinous layer, visible as a dark line in section (Ryvarden 2010). It has a light-coloured, more or less tuberculate hymenium. The hyphal system is trimitic, consisting of skeletal and binding hyphae with thick walls and few clamp connections, and thin-walled, generative hyphae with clamp connections. A trimitic subiculum is seen, composed of horizontal, light-coloured skeletal hyphae, metuloid cystidia, thick-walled, encrusted; basidia clavate, with 4 sterigmata and a basal clamp; spores globose, somewhat thick-walled, echinulate, amyloid. It was originally described with *Laurilia taxodii,* but this was transferred to *Lauriliella* S.H. He & Nakasone, and *Laurilia* are now represented with the single species, *Laurilia sulcata* (Liu et al. 2017b).

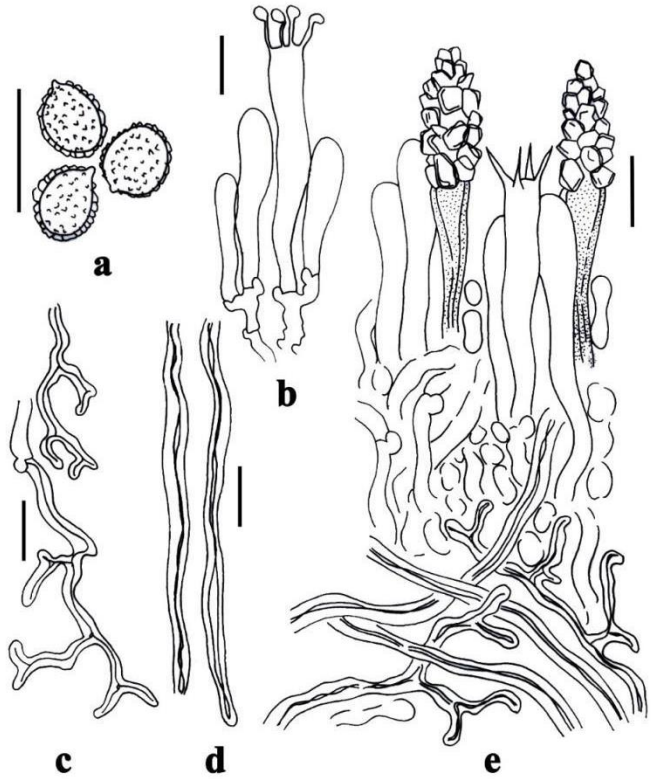


Fig. 217 – ***Laurilia sulcata*** (CLZhao 31188, holotype). a Basidiospores. b Basidia. c Basidioles. d Section of hymenium. e Section through the hymenium. Scale bars: a, b, e = 10 μm, c, d = 20 μm. Redrawn from Ryvarden (2010). For original basidiomata, refer to Liu et al (2017).

Although historically recognised based on unique morphological characters, *Laurilia* is not supported as a distinct clade in modern molecular phylogenetic analyses (Liu et al. 2017b, Justo et al. 2017). Most recent classifications suggest that the genus should be treated as synonymous with or nested within *Stereum* Hill ex Pers. or other genera in *Stereaceae* Pilát or *Polyporales*, depending on the analysis and alignment scheme (Liu et al. 2017b).

To accommodate the unique features of a notably distinct species, *Stereum sulcatum* Burt, *Laurilia* was established, defined by a minimal superficial tomentum, composed of nodose, generative hyphae rather than skeletal, which is a distinguishing trait among dimitic, amylosporous members of *Stereum* (Pouzar 1959). Eriksson (1958a) also supported the view that *S. sulcatum* merits recognition at the generic level (Pouzar 1959). The type species is easily distinguished from other stereoid fungi due to the smooth hymenium and by possessing a trimitic hyphal system, which is in alignment with the family *Echinodontiaceae* due to several shared characteristics (Ryvarden 2010). *Laurilia sulcata* exhibits a trimitic hyphal system characterised by branched binding hyphae and is typically found on dead branches and trunks of *Pinaceae*. In contrast, species of *Lauriliella* possess a dimitic hyphal system and are commonly associated with living trees of the Cupressaceae (Liu et al. 2017b).

Although similar in some characters, the type species of *Echinodontium* Ellis & Everh. and *Laurilia* can be easily distinguished in morphology. *E. tinctorium* (Ellis & Everh.) Ellis & Everh. has pileate to ungulate basidiomata, a coarsely dentate hymenophore, brick red-coloured context, and a dimitic hyphal system. In contrast, *Laurilia sulcata* has resupinate to effuse-reflexed basidiomata, smooth to tuberculate hymenophore, beige subiculum, and a trimitic hyphal system (Liu et al. 2017b).

Type species: *Laurilia sulcata* (Burt) Pouzar

Basionym: *Stereum sulcatum* Burt

Steccherichium D.A. Reid, Kew Bulletin 17(2), 270

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 218

Classification: *Bondarzewiaceae, Russulales, Agaricomycetes, Agaricomycotina, Basidiomycota*, *Fungi*

Steccherichium is a hydnaceous genus established by D.A. Reid in 1963, with *S. seriatum* (Lloyd) Maas Geest. as the type species (Yuan & Dai 2008). The wood-decaying genus *Steccherichium* is distributed worldwide (He et al. 2019). This fungus has distinctive effused-reflexed to pileate basidiomata featuring an aculeate hymenial surface (Angelini & Losi 2024). Basidiospores are ellipsoid, warted, and strongly amyloid (Maas Geesteranus 1974, Yuan & Dai 2008, Angelini & Losi 2024). The hyphal system is monomitic to imperfectly dimitic, with clamped generative hyphae (Yuan & Dai 2008, Angelini & Losi 2024). Cystidia are tubular and thick-walled (Yuan & Dai 2008).

Yuan & Dai (2008) reported that the species of *Steccherinum* Gray macroscopically resemble those of *Steccherichium*. However, *Steccherinum* has encrusted skeleto-cystidia and smooth, non-amyloid basidiospores (Banker 1912, Yuan & Dai 2008). Furthermore, the basidiomata of *Steccherinum* are consistently leathery, while those of *Steccherichium* are corky (Yuan & Dai 2008). Identification of *Steccherichium* species is solely based on macro- and micromorphology, and no molecular evidence is reported (He et al. 2019). The classification of *Steccherichium* in Species Fungorum, MycoBank, UNITE, and Hyde et al. (2024a) is under *Bondarzewiaceae*, whereas GenBank lists it under *Wrightoporiaceae* and may need updating. Currently, Species Fungorum (2026) lists six species of *Steccherichium*.

Type species: *Steccherichium seriatum* (Lloyd) Maas Geest

Basionym: *Hydnum seriatum* Lloyd

Other accepted species:

S. abditum Maas Geest.

S. acanthophysium T. Hatt. & Ryvarden

S. dimiticum Douanla-Meli

S. isabellinum Corner
S. rusticum Maas Geest.

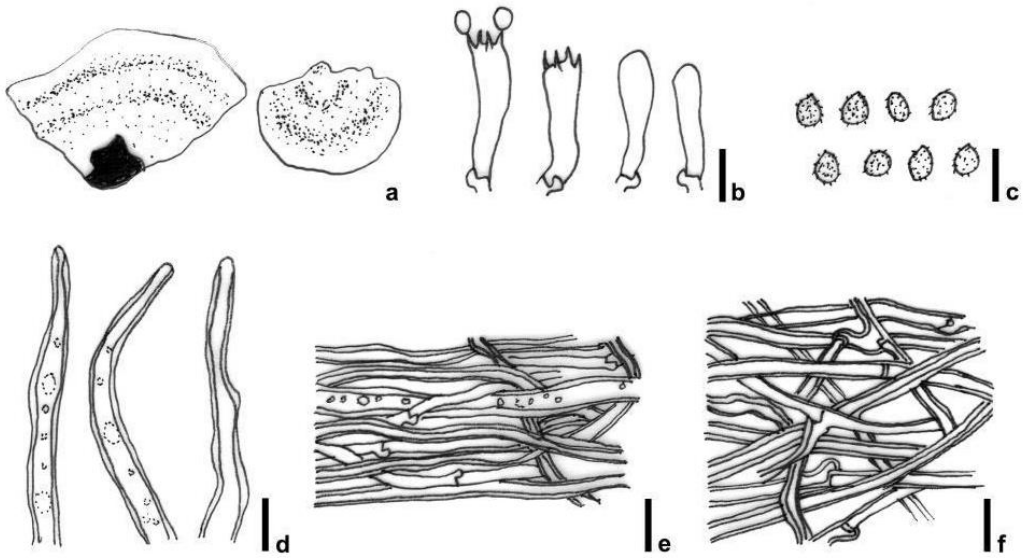


Fig. 218 – ***Steccherichium seriatum*** (Yuan 1629). a Basidiomata. b Basidia and basidioles. c Basidiospores. d Gloeocystidia. e Hypha from trama. f Hyphae from context. Scale bar: b, d–f = 10 µm, c = 5 µm. Redrawn from Yuan & Dai (2008).

Wrightoporia Pouzar, Česká Mykologie 20(3), 173
Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 219
Classification: *Bondarzewiaceae, Russulales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Wrightoporia was described in honour of the Argentinian mycologist Jorge Eduardo Wright, who first detected and described the unusual microscopic features (notably the dextrinoid, cyanophilous skeletal hyphae and amyloid spores) in *W. avellanea* (Bres.) Pouzar (Pouzar 1966a). The genus is typified with *W. lenta* (Overh. & J. Lowe) Pouzar, described based on morphological characters only (Pouzar 1966a, Chen & Cui 2014). Species in the genus are wood-inhabiting, causing white-rot, and are distributed worldwide, including Southeast Asia, Europe, and North America (Hattori 2008, Chen et al. 2016).

Basidiomata of *Wrightoporia* are annual, resupinate, soft, and cottony when fresh, becoming membranous to cottony upon drying. The pore surface is white to cream or pale brown, and the margin often has rhizomorphs (Pouzar 1966a). The pores are large, elongated, round to angular, and the subiculum is cottony (Pouzar 1966a, Chen et al. 2016, Zhou et al. 2020b). Basidiospores are ellipsoid or shortly elliptical to subglobose, hyaline, thin- to slightly thick-walled, inamyloid, indextrinoid and finely asperulate acyanophilous walled covered by strongly amyloid warts or ridges. The hyphal system is dimitic, with clamped thin-walled generative hyphae with inamyloid, indextrinoid, acyanophilous wall and aseptate, unbranched, long, narrow, strongly dextrinoid, cyanophilous but inamyloid skeletal hyphae (Pouzar 1966a, Zhou et al. 2020b). Gloeoplerous hyphae are usually present, while gloeocystidia and cystidia are variably present (Zhou et al. 2020b).

The phylogenetic relationships among most species of *Wrightoporia sensu lato* are ambiguous, as phylogenetic studies have shown that species are distributed across at least two families (Chen & Cui 2014). A pivotal global molecular study, considering 140 specimens, examined ITS and LSU sequences and recovered six clades within the traditionally circumscribed *Wrightoporia sensu lato*, indicating that the genus is strongly polyphyletic. *Wrightoporia sensu stricto* includes the type *W. lenta* and is often treated as *Wrightoporiaceae* (Chen et al. 2016).

Presence or absence of gloeoplerous hyphae and/or gloeocystidia is an important character to delineate species in *Wrightoporia* (David & Rajchenberg 1987, Chen & Cui 2014). *Anomoporia* Pouzar is the only other polypore genus with amyloid spores and is considered phylogenetically related to *Wrightoporia,* but its monomitic context, formed of indextrinoid, acyanophilous hyphae, clearly distinguishes it from the latter (Pouzar 1966a). The classification of *Wrightoporia* in Species Fungorum, UNITE, and Hyde et al. (2024a) is under *Bondarzewiaceae*, whereas MycoBank and GenBank list it under *Wrightoporiaceae* and may need updating. Currently, Species Fungorum (2026) lists 33 species of *Wrightoporia*.

Type species: *Wrightoporia lenta* (Overh. & J. Lowe) Pouzar

Basionym: *Poria lenta* Overh. & J. Lowe

Other accepted species: (Species Fungorum – search *Wrightoporia*)

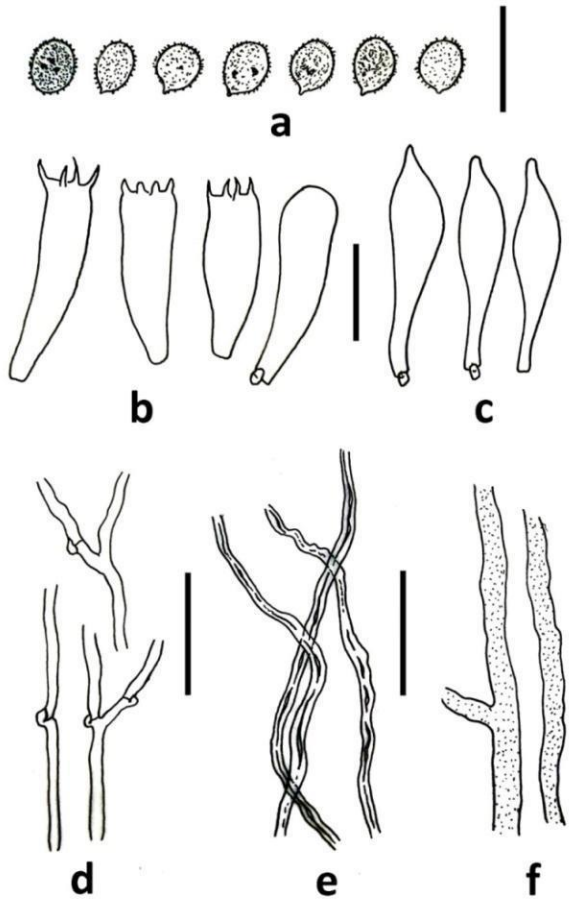


Fig. 219 – *Wrightoporia lenta* (F-21073). a Basidiospores. b Basidia and basidiole. c Hymenial cystidioles. d Generative hyphae from trama. e Skeletal hyphae from trama. f Gloeoplerous hyphae from trama. Redrawn from Hattori (2008). For original basidiomata, refer to Chen et al (2016) and Zhou et al (2020).

Stereaceae Pilát, Hedwigia 70, 34

Species Fungorum, Facesoffungi, MycoBank, GenBank

Classification: *Russulales, Agaricomycetes, Agaricomycotina, Basidiomycota*, *Fungi*

Stereaceae includes saprobic white-rot fungi that are corticioid or stereoid, characterised by a hymenophore that is usually smooth, but sometimes tuberculate or merulioid (Xu et al. 2025). The microscopic characters include the presence of gloeocystidia (known as skeletocystidia) and amyloid basidiospores with smooth to ornamented surfaces (Larsson & Larsson 2003, Bernicchia & Gorjón 2010). *Stereaceae* forms a monophyletic clade in order *Russulales* Kreisel ex P.M. Kirk, P.F. Cannon & J.C. David and is typified by *Stereum* Hill ex Pers. (Larsson & Larsson 2003, Larsson 2007). Previously, most species in the family were placed in *Stereum*, *Xylobolus* P. Karst., *Aleurodiscus* Rabenh. ex J. Schröt. *sensu lato*, and *Gloeocystidiellum* Donk *sensu lato* (Xu et al.

2025). While *Stereum sensu stricto* and *Xylobolus* are monophyletic, the latter two genera were found to be highly polyphyletic, leaving the generic classification of *Stereaceae* partly unresolved (Wu et al. 2001, Larsson & Larsson 2003, Wu et al. 2010b, Phookamsak et al. 2019). Reassessment of the family by Xu et al. (2025) was conducted based on morphology and phylogeny. Fourteen lineages were identified, including two new genera (*Confertotrama* Nakasone & S.H. He and *Gelatinostereum* S.H. He, S.L. Liu & Y.C. Dai), nine new species, and 20 new combinations, with several genera redefined or synonymised. Currently, the family includes 20 genera (Hyde et al. 2024a).

Acanthophysellum Parmasto, Eesti NSV Teaduste Akadeemia Toimetised, Seeria Bioloogia 16(4), 377

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 220

Classification: *Stereaceae, Russulales, Agaricomycetes, Agaricomycotina, Basidiomycota*, *Fungi*

Acanthophysellum was established by Parmasto (1967) to accommodate resupinate, corticoid fungi with distinctive acanthophyses (spiny hyphal elements) (Parmasto 1967). The type species, *A. canadense*, was originally described as *Aleurodiscus canadensis* by Skolko (1944). The genus is characterised by a monomitic hyphal system, presence of gloeocystidia and acanthophyses, and ellipsoid, amyloid to dextrinoid spores (Wu et al. 2000). Species within this genus are typically saprotrophic (wood-inhabiting) on angiosperms and gymnosperms and cause white rot. They are widely distributed in temperate regions of the Northern Hemisphere, including Europe and North America (Trichies 2001, Martini 2016).

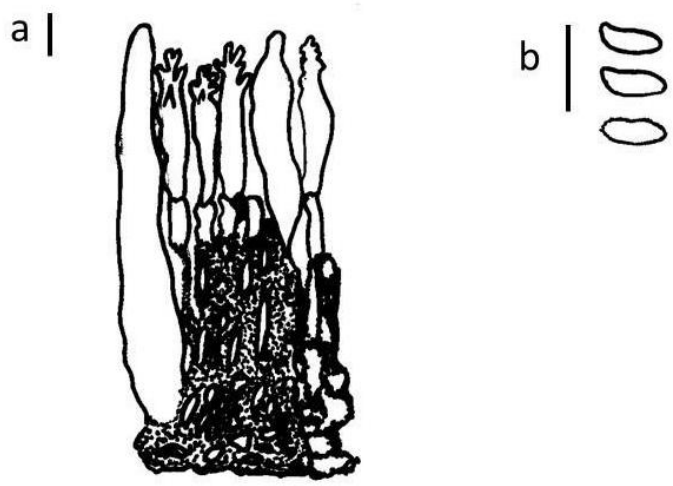


Fig. 220 – ***Acanthophysellum lividocoeruleum***. a Basidiomata cross-section. b Basidiospores. Scale bars: a–b = 10 µm. Redrawn from Gierczyk & Kujawa (2020). For original basidiomata, refer to Gierczyk & Kujawa (2020).

The basidiomata of *Acanthophysellum* are resupinate, adherent, and ceraceous to crustose. The hymenophore is smooth to finely prunose, white to yellowish. Hyphae bear clamp connections. Acanthophyses are numerous, hyphoid to clavate, with apical brush-shaped outgrowths, while gloeocystidia are moniliform. Basidia are clavate to cylindrical, typically 2-spored, while basidiospores are ellipsoid, smooth, thick-walled, and exhibit a mixed amyloid-dextrinoid reaction in Melzer's reagent (Skolko 1944, Wu et al. 2000). Existing taxonomic accounts of *Acanthophysellum* (Martini 2016, Gierczyk et al. 2020) lack molecular data, so species boundaries and descriptions remain contingent solely on morphological characters. The classification of *Acanthophysellum* in *Stereaceae, Russulales, Agaricomycetes, Agaricomycotina*, and *Basidiomycota* agrees in Species Fungorum, MycoBank, GenBank, UNITE, and the latest Outline

of Fungi and fungus-like taxa (Hyde et al. 2024a). Currently, Species Fungorum (2026) lists four species of *Acanthophysellum.*

Type species: *Acanthophysellum canadense* (Skolko) Sheng H. Wu, Boidin & C.Y. Chien

Basionym: *Aleurodiscus canadensis* Skolko

Other accepted species:

A. fennicum (Laurila) Bernicchia & Gorjón

A. propinquum (Boidin & Gilles) Boidin & Gilles

A. verecundum Duhem

Thelephorales Corner ex Oberw., Sydowia 28(1–6), 361

Species Fungorum, Facesoffungi, MycoBank, GenBank

Bankeraceae Donk, Persoonia 1(4), 405

Species Fungorum, Facesoffungi, MycoBank, GenBank

Classification: *Thelephorales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Bankeraceae was established by M.A. Donk in 1961 and typified with *Bankera* Coker & Beers ex Pouzar (=*Phellodon*) (Donk 1961). The family consists of 6 genera: *Boletopsis* Fayod, *Corneroporus* T. Hatt., *Hydnellum* P. Karst., *Neosarcodon* Xiao L. He, Di Wang & W.H. Peng, *Phellodon* P. Karst., and *Sarcodon* Quél. ex P. Karst. (Hyde et al. 2024a). Members of *Bankeraceae* are characterised by stipitate and hydnoid or stipitate and poroid basidiomata (He et al. 2024).

Hydnellum P. Karst., Meddelanden af Societas pro Fauna et Flora Fennica 5, 41

Species Fungorum, Facesoffungi, MycoBank, GenBank Fig. 221

Classification: *Bankeraceae, Thelephorales, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi*

Hydnellum is a hydnoid genus that was established by P. Karst. in 1879, typified by *H. suaveolens* (Scop.) P. Karst (Maas Geesteranus 1975, Loizides et al. 2016). *Hydnellum* is an important genus within *Bankeracea*, well-known for forming ectomycorrhiza associations with woody plants, particularly those in the *Pinaceae* and *Fagaceae* (Nitare et al. 2021, Mu et al. 2021, Song et al. 2022). *Hydnellum* is a cosmopolitan genus, with over 130 records in Species Fungorum (2025), and is mainly distributed in Asia, Europe, and North America, with a few species reported from Oceania (Maas Geesteranus 1975, Loizides et al. 2016). *Hydnellum* is characterised by stipitate and corky to woody basidiomata, spinous hymenophore, irregularly ellipsoidal to globose spores with tuberculate, the surface of pileus scaled or unscaled, background banded or un-banded, and some taxa showing olive or blue-green colour in KOH (Maas Geesteranus 1975, Baird & Khan 1986, Baird et al. 2013, Mu et al. 2021). *Hydnellum* and *Sarcodon* have similar basidiomata with a hymenium made up of spines and yellow to brown-tinted basidiospores. However, *Hydnellum* can be distinguished from *Sarcodon* by its smaller basidiospores (Larsson et al. 2019).

Recent taxonomic studies, incorporating morphological characteristics and phylogenetic analysis, have redefined the scope of *Hydnellum,* transferring many species from *Sarcodon* to *Hydnellum* (Larsson et al. 2019, Mu et al. 2021). Mu et al. (2021) identified ten subgenera within *Hydnellum*, using four genes (ITS, LSU, SSU, and *rpb2*) and morphological characteristics. Hyde et al. (2024a) recognised approximately 90 species worldwide. The classification of *Hydnellum* in Species Fungorum, MycoBank, UNITE, and Hyde et al. (2024a) is under *Bankeraceae*, whereas GenBank lists it under *Thelephoraceae* and may need updating.

Synonymy: *Calodon* P. Karst. *Phaeodon* J. Schröt.

Type species: *Hydnellum suaveolens* (Scop.) P. Karst.

Basionym: *Hydnum suaveolens* Scop.

Other accepted species: (Species Fungorum – search *Hydnellum*)

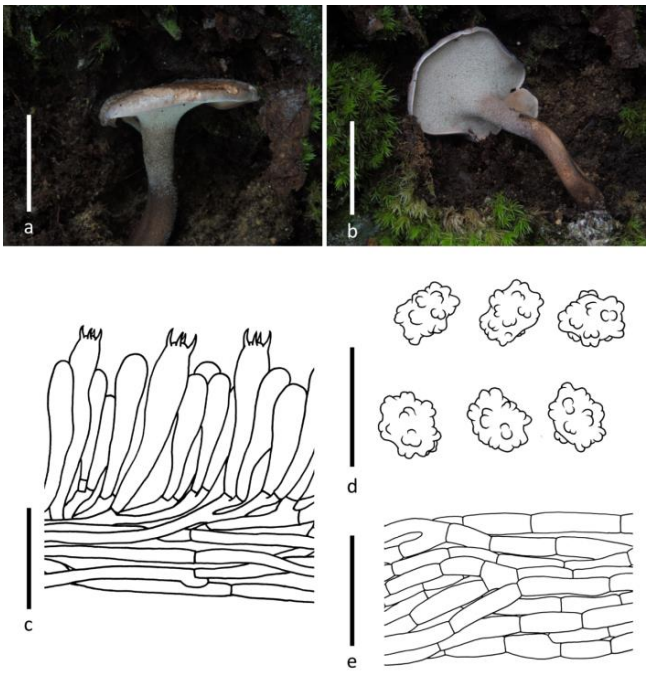


Fig. 221 – ***Hydnellum ailaoense*** (HKAS 125553, holotype). a, b Typical mature basidiomata. c Basidia. d Basidiospores. e Hyphae from pileus context. Scale bar: a, b = 5 cm, c, e = 20 µm, d = 10 µm. Photo credit: Lei et al. (2023). For original basidiomata, refer to Lei et al. (2023).

Agaricomycetes genera incertae sedis

Taiwanoporia T.T. Chang & W.N. Chou, Mycologia 95(6), 1215

Species Fungorum, Facesoffungi, MycoBank Fig. 222

Classification: *Incertae sedis, Incertae sedis, Agaricomycetes, Agaricomycotina*, *Basidiomycota*, *Fungi*

A unique aphyllophoralean species found in Taiwan could not be assigned to any specific genus (Chang & Chou 2003). It was characterised by resupinate to sessile basidiomata with a poroid hymenium, and positive amyloid reaction of the basidiospores, similar to five other aphyllophoralean genera: *Amylonotus* Ryvarden, *Amylosporus* Ryvarden, *Anomoporia* Pouzar, *Echinodontium* Ellis & Everh., and *Wrightoporia* Pouzar. However, this species can be differentiated from *Anomoporia* in terms of the absence of clamped generative hyphae, from *Amylosporus* by the presence of a monomitic hyphal system, and from *Amylonotus*, *Echinodontium*, and *Wrightoporia* by the smooth basidiospores. Thus, the genus *Taiwanoporia* was established to accommodate this species, which is named *T. amylospora* T.T. Chang & W.N. Chou (Chang & Chou 2003). It is classified as family *incertae sedis*.

The etymology of *Taiwanoporia* refers to the place of its first discovery, Taiwan, and the poroid hymenium (Chang & Chou 2003). The basidiomata of this genus are whitish to creamy, annual, and effuso-reflexed to pileate. The pores in the hymenophore are rounded to angular. The hyphal system is monomitic with simple septate hyphae and the absence of any clamps in generative hyphae. Basidiospores are amyloid, hyaline, tear-shaped, and have smooth to fine warted surfaces. *Taiwanoporia* causes white rot on its host trees (Chang & Chou 2003). Another species, *Taiwanoporia roseotincta* T. Hatt., was reported from Japan by Hattori (2008). This species is similar to *T. amylospora* but differs in its echinulate surface ornamentation of basidiospores (Hattori 2008).

The taxonomic delineation of this genus and its constituent species currently rests exclusively on morphological criteria; molecular phylogenetic assessments remain unperformed. Currently, only the two species of *Taiwanoporia* are recognised worldwide (Hyde et al. 2024a). The classification of *Taiwanoporia* in *Incertae sedis, Incertae sedis, Agaricomycetes, Agaricomycotina*,

and *Basidiomycota* agrees in Species Fungorum, MycoBank, UNITE, and the latest Outline of Fungi and fungus-like taxa (Hyde et al. 2024a).

Type species: *Taiwanoporia amylospora* T.T. Chang & W.N. Chou.

Other accepted species: *T. roseotincta* T. Hatt.

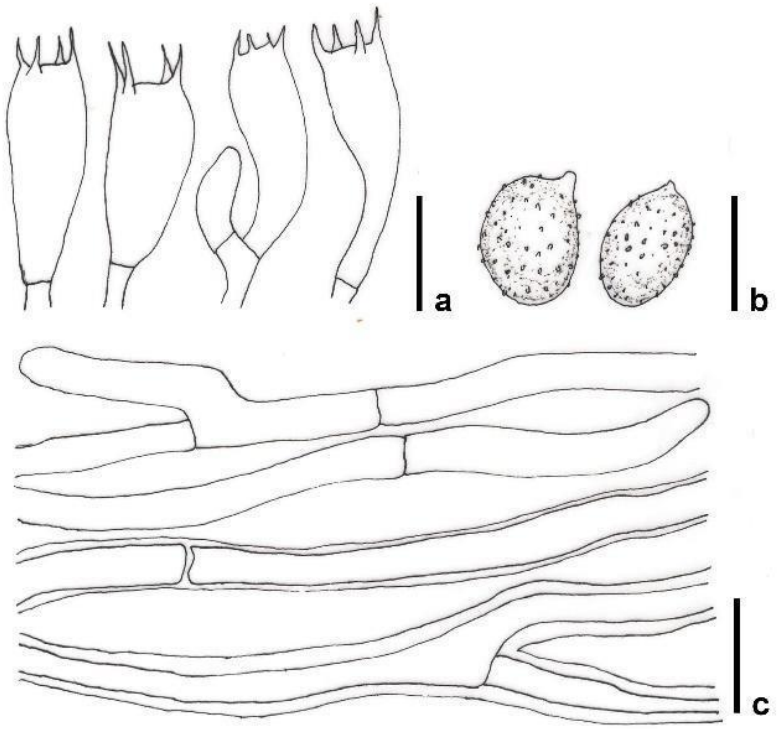


Fig. 222 – ***Taiwanoporia amylospora***. a Basidia. b Basidiospores under SEM. c Generative hyphae. Scale bars: a, c = 10 μm, b = 5 μm. Redrawn from Chang & Chou (2003).

Section 2: Notes on terms related to mushroom mycelium-based biomaterials

3D-printing with mycelium

3D printing is a technique used to develop products by depositing materials only where needed, thereby limiting waste generation compared to other processes (Mohseni et al. 2023, Soh et al. 2023). Mushroom mycelium is a vegetative part composed of hyphae that is used to bind discrete lignocellulosic particles or substrates to develop mushroom mycelium-based biomaterials (Soh et al. 2023, Khyaju & Luangharn 2024). In 3D printing of mycelium-based biomaterials, mycelium and byproducts or substrates such as coffee grounds, cardboard, and sugarcane waste are mixed (Mohseni et al. 2023, Soh et al. 2023). Studies have exhibited its ability to easily design printed structures with air channels that facilitate mycelium growth (Soh et al. 2023). A gelling agent such as chitosan or guar gum is also used along with lignocellulosic substrate in 3D mycelium printing (Elsacker et al. 2022, Soh et al. 2023).

This 3D printing method enabled the development of complex structures without the need to design and fabricate a complex mould (Soh et al. 2023). The major challenges in 3D printing using living organisms like mushroom mycelium are the maintenance of sterilised conditions throughout the entire process and the utilisation of specialised equipment (Murphy & Atala 2014, Yan et al. 2018, Mohseni et al. 2023, Soh et al. 2023). Additionally, only fine substrate particles enable the operation of small-nozzled printing equipment, thereby providing higher precision and resolution in the final products (Soh et al. 2023). However, 3D printing using mushroom mycelium and suitable substrates has provided a promising alternative to develop sustainable, non-polluting, and biodegradable materials.

Acoustic insulation Fig. 223

Acoustic insulation is a method used to minimise sound transmission by absorbing or blocking sound waves. It is installed as panels on ceilings and walls, helping to manage noise in residential, commercial, and industrial settings. Various insulation materials have been developed, such as foam panels, rock mineral wools, fibreglass, plasterboards, and mushroom mycelium-based biomaterials (Bonga et al. 2024). While synthetic insulation materials are widely used globally, they are neither sustainable nor environmentally friendly. In contrast, bio-based insulation materials such as mycelium-based biomaterials have been tested and manufactured. Companies, including MOGU (www.mogu.bio) and BIOHM (www.biohm.co.uk), produce acoustic panels of mycelium-based biomaterials on a commercial scale. Mycelium-based biomaterials are considered insulation materials due to their lower energy efficiency, sustainability, and biodegradability. Their fibrous, porous, and low-density nature makes mycelium-based biomaterials effective for acoustic insulation. Regarding mycelium-based biomaterials, higher-density materials exhibit better performance than non-pressed materials (Brito Guerrero de Escalante 2023). Notably, mycelium-based biomaterials have been shown to reduce noise by three-quarters at 1000 Hz (Jones et al. 2020, Brito Guerrero de Escalante 2023).

Basidiomata Fig. 224

Basidiomata (singular: basidioma) are the reproductive structures or fruiting bodies of *Basidiomycota*. They exhibit diverse shapes, sizes, and colours, including mushrooms, brackets, puffballs, stinkhorns, and jelly fungi. These fungi play significant ecological roles as saprobes, parasites, and ectomycorrhizae. Mushrooms are also highly prized as a source of food, supplements, and medicine. Basidiomata are morphologically defined by the presence of a pileus, a fertile hymenophore that may manifest as lamellae, poroid surfaces, or aculeate teeth, and a supporting stipe. Basidia are specialised cells in basidiomata that produce and release basidiospores. Both the basidiospores and the context mycelium can be used for isolation to develop pure cultures. The pure culture is utilised in spawn preparation and inoculation of substrates to prepare mushroom mycelium-based biomaterials (Khyaju & Luangharn 2024). Basidiomata are sometimes directly crushed and processed for biomaterial production (Bustillos et al. 2020, Porter & Naleway 2022). Alternatively, researchers such as Müller et al. (2021) and Pylkkänen et al. (2023) cultivated basidiomata in moulds, allowing them to grow into predefined shapes and sizes of products to obtain biomaterials.



Fig. 223 – Acoustic insulation block developed using mycelium and sawdust.

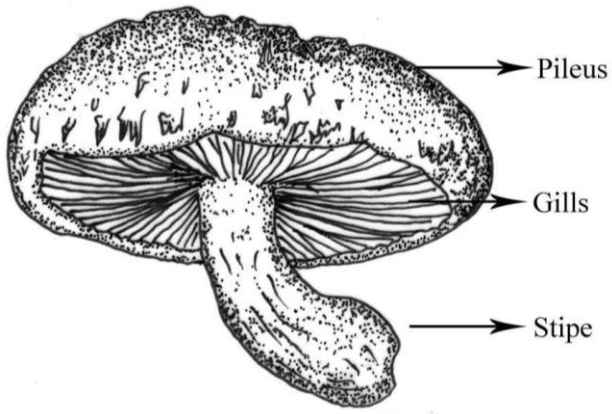


Fig. 224 – Basidiomata of *Lentinula edodes* show pileus, gills, and stipe. Redrawn from Pegler (1983b).

Beta-glucans Fig. 225

Beta-glucans (β-glucan) are naturally occurring soluble fibres or polysaccharides found in the cell wall of fungi, bacteria, yeast, and some cereals (Wasser & Weis 1999, Rop et al. 2009, El Khoury et al. 2012, Thanasannubanant et al. 2025). These bioactive compounds are well known for their health-promoting effects, including the regulation of insulin resistance, hypertension, dyslipidemia, and obesity (El Khoury et al. 2012).

In mushrooms, beta-glucans are the most abundant structural polysaccharides, forming essential components of the fungal cell walls, in linear and branched form, consisting of *β*-1,3 and *β*-1,6 glycosidic linkages (Ruiz-Herrera & Ortiz-Castellanos 2019). These molecular linkages form a micro-fibril structure that plays an important role in cell wall architecture, resistance, and mechanical strength (Rop et al. 2009, Ruiz-Herrera & Ortiz-Castellanos 2019).

In the development of mushroom mycelium-based biomaterials, β-glucans are instrumental in binding substrate particles together during mycelial colonisation (Ruiz-Herrera & Ortiz-Castellanos 2019). Their adhesive properties support the formation of a cohesive material matrix. Moreover, β-glucans are biodegradable, breaking down naturally into glucose, thereby contributing to the environmental sustainability and degradability of mycelium-based biomaterials.

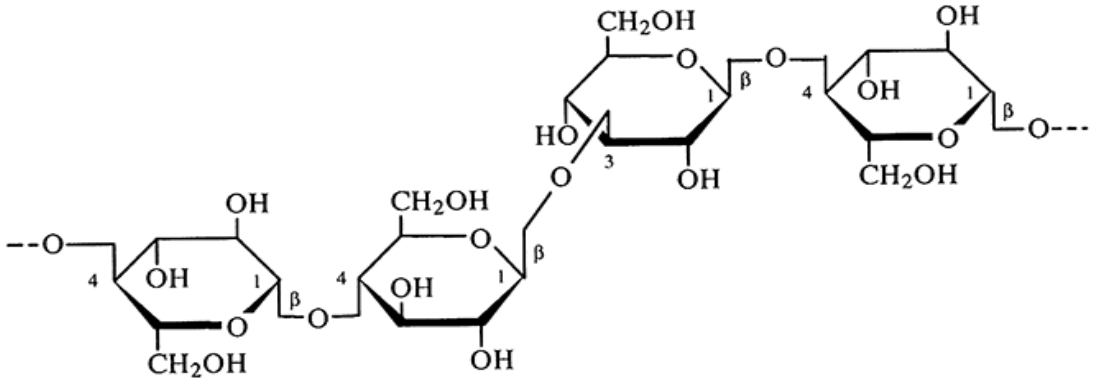


Fig. 225 – Structure of *β*-glucans. Image credit: Rop et al. (2009).

Biochar

Biochar is a carbon-rich material produced through the pyrolysis of organic matter, including agricultural wastes, wood, and municipal solid waste (Lehmann & Joseph 2009, Wang & Wang 2019, Choi et al. 2023). It possesses several beneficial properties, such as high carbon content, strong cation exchange capacity, a large surface area, and structural stability (Sepehri & Sarrafzadeh 2018, Wang & Wang 2019). In mushroom mycelium-based biomaterials, fire testing

has demonstrated the formation of a protective char layer on the surface, which effectively inhibits combustion and heat penetration (Choi et al. 2023). Due to these higher char yields, mycelium-based biomaterials exhibited superior fire resistance compared to conventional plastics (Jones et al. 2018). Additionally, the pyrolysis process leads to shrinkage in mycelium diameter while preserving the fibrous structure, further enhancing the fire-retardant behaviour of materials (Jones et al. 2018).

Biodegradability

The ability of a material to decompose naturally into simpler compounds like carbon dioxide, water, and organic matter is termed biodegradability. Microorganisms, such as bacteria and fungi, degrade complex materials, leading to a reduction in the weight and volume of the material. The decomposition of organic matter affects the formation and functioning of soil in nature (Smagin et al. 2018).

The biodegradability of biomaterials is a key benefit over plastic-based or synthetic products. The rate of degradation is affected by environmental conditions, including temperature, moisture, and oxygen levels. Mushroom mycelium-based biomaterials exhibit high biodegradability, making them an eco-friendly product that aligns with the principles of the circular economy. For instance, mycelium-based biomaterials exhibited weight loss of 61 to 85 % in 90 days of soil burial (Aiduang et al. 2024, Khyaju et al. 2026). The biodegradability of a material is tested by burying it in soil for a specific duration. The samples are retrieved at intervals of 15, 30, 45, 60, 75, and 90 days, cleaned to remove adherent soil, and dried at 60°C until reaching a stable weight. The initials and final weights are recorded, and the weight loss percentage is calculated using the following formula (Juanga-Labayen & Yuan 2021, Aiduang et al. 2024).

$$WL\ (\%) = \frac{Wi - Wt}{Wi} \times 100\%$$

where,

WL = Weight loss (%), W_i = initial weight (g), W_t = weight after the given time (g)

Biomaterial packaging Fig. 226

The global challenge of environmental pollution is driven by plastic-based packaging products such as polystyrene or styrofoam (Abhijith et al. 2018). Biomaterial packaging refers to alternative packaging solutions derived from renewable and biodegradable materials based on biological sources. Biomaterials are eco-friendly, sustainable, lightweight, energy-efficient, and have a lower carbon footprint. Among the various biomaterial packaging options, mushroom mycelium-based biomaterials are an innovative alternative to traditional plastic. The mycelium-based biomaterials are developed using mushroom mycelium and lignocellulosic substrates (Abhijith et al. 2018, Vandelook et al. 2021). Mycelium-based biomaterials are fully biodegradable and renewable, making them an attractive and sustainable packaging option (Asore 2021). Some companies, such as Dell, IKEA, and Ecovative Design, have already incorporated mycelium-based biomaterials for packaging electronics, beverages, cosmetics, and fragile items (Holt et al. 2012, Iordache et al. 2018, Vandelook et al. 2021).

Biopolymer

Biopolymers are natural polymers synthesised by living organisms, including plants, animals, and microorganisms. Common biopolymers include cellulose, chitin, starch, proteins, and nucleic acids, all of which are typically biodegradable and environmentally sustainable (Liu et al. 2023b). These polymers are formed from monomeric units such as sugars, amino acids, and nucleotides. For example, proteins are composed of long chains of amino acid residues, while lignin is an amorphous, cross-linked polymer derived from phenolic precursors. Lignin exhibits several beneficial properties, including antioxidant activity, high thermal stability, chemical reactivity, and adhesive characteristics (Naseem et al. 2016, Liu et al. 2023b). In certain applications, biopolymers

are extracted from various mushroom species (Hassan et al. 2019, Benbelkacem et al. 2022). In the development of mushroom mycelium-based biomaterials, the mycelium functions as a natural binder due to its rich biopolymer content. Key criteria for selecting biopolymers for their applications include biocompatibility, non-toxicity, and the ability to support favourable biological growth (Hassan et al. 2019).



Fig. 226 – Biomaterial packaging from mushroom mycelium-based biomaterials.

Carbon footprint

A carbon footprint, also known as a greenhouse gas footprint, refers to the quantified amount of greenhouse gases emitted into the atmosphere. It measures the total amount of mainly carbon dioxide emissions, directly and indirectly, associated with an activity and accumulated throughout a product's lifecycle (Wiedmann & Minx 2008). The carbon footprint of a product can vary significantly based on factors such as production, processing, transportation, and disposal. Carbon emissions are measured using three methods: input-output analysis, life cycle assessment (LCA), and IO-LCA (Gao et al. 2014). In 2006, the International Organization for Standardization (ISO) introduced the ISO14064 standard, which provides guidelines for measuring and managing greenhouse gas emissions (Gao et al. 2014).

The GHGs are major contributors to global warming and present a significant challenge for sustainability and humanity (Gao et al. 2014). To address this growing threat, several international agreements have been established, including the United Nations Framework Convention on Climate Change, the Kyoto Protocol, the Bali roadmap, and the Copenhagen Agreement (Gao et al. 2014). These initiatives have encouraged the creation of eco-friendly, sustainable, and biodegradable products. Among these innovations, mushroom mycelium-based biomaterials have emerged as a promising solution with a low carbon footprint. Mycelium-based biomaterials are developed using the vegetative part of mushrooms called mycelium and agricultural or forest byproducts (Khyaju & Luangharn 2024). Both mycelium and these byproducts are renewable natural resources, and mycelium-based biomaterials are increasingly used in various applications, including packaging, construction, architectural design, insulation, and textiles.

Carbon sequestration

Carbon sequestration is the process of capturing and storing atmospheric carbon dioxide (CO_2) in biological and geological reservoirs to reduce the concentration of CO_2 in the atmosphere (Lal 2008). Globally, the major carbon pools include the biotic, pedologic (soil), atmospheric, oceanic, and fossil fuel (Lal 2008). Reducing atmospheric CO_2 through various carbon management techniques is a key strategy to combat global warming and climate change. Among these, carbon-neutral technologies play a central role (Lal 2008). In mushroom mycelium-based biomaterials production, lignocellulosic substrates are utilised along with mycelium, which

otherwise might be burnt, releasing CO_2 into the atmosphere (Khyaju & Luangharn 2024). Agricultural and forest byproducts are used as input resources for mycelium-based biomaterial production (Khyaju & Luangharn 2024). Mycelium-based biomaterials production aligns with the principles of the circular economy, in which waste materials are transformed into valuable and renewable resources (Hyde et al. 2024c). By substituting traditional petroleum-based plastics with biodegradable mycelium-based biomaterials, this approach also reduces environmental pollution, particularly in oceans, air, and landfills. Notably, the life cycle assessment of mycelium-based biomaterial production using mushroom mycelium and agricultural byproducts results in a net carbon sink (Livne et al. 2022). Mycelium-based fungal biomaterials are now being deployed across diverse industrial sectors—ranging from protective packaging, low-impact building composites, and high-performance thermal–acoustic insulation to engineered textiles, furniture substrates, and bio-integrated architectural components. By substituting energy-intensive, petro-derived feedstocks, these hyphal matrices not only avoid upstream greenhouse-gas emissions but also function as active biological carbon sinks, thereby providing a quantifiable, scalable strategy for climate-change mitigation (Livne et al. 2022, Khyaju & Luangharn 2024).

Chemical characterisation

Characterisation of the chemical profile of fungal mycelium-based biomaterials is typically achieved with Fourier-transform infrared spectroscopy (FTIR), thermogravimetric analysis (TGA), and quantitative assays for pH, total nitrogen, organic matter (OM), and electrical conductivity (Aiduang et al. 2022). The hyphal matrix is dominated by polysaccharides (chitin, β-glucans, chitosan), proteins (hydrophobins, extracellular enzymes) and lipids (predominantly C16–C18 fatty acids). These constituents dictate key physicochemical attributes—mechanical strength, moisture sorption and biodegradation kinetics. Specifically, elevated cellulose fractions increase hygroscopic capacity, whereas progressive mycelial fermentation lowers bulk pH. Furthermore, the final OM content of the colonised substrate is lower than that of the original lignocellulosic feedstock, reflecting metabolic conversion by the fungus (Aiduang et al. 2022, Khyaju et al. 2026). Notably, due to their natural constituents, mycelium-based biomaterials are fully biodegradable, offering a sustainable alternative to petroleum-based plastic and foam products (Alemu et al. 2022a).

Chitin Fig. 227

Chitin is a long-chain biopolymer composed of an amide derivative of glucose, N-acetylglucosamine, linked by β-(1→4) bonds (Kalutharage & Rathnasinghe 2020). It is structurally similar to cellulose, except that the hydroxyl group in cellulose is substituted by acetyl amine (Alimi et al. 2023). The chitin synthesis mechanism is highly conserved and involves several enzymes, with chitin synthase being the principal enzyme (Merzendorfer 2011). It is often cross-linked with glucans and proteins, giving flexibility to the cell wall. Fungal chitin exhibits crystalline micro-fibrils in three isomeric forms: α-chitin, β-chitin, and γ-chitin (Ru et al. 2019). Among these, α-chitin is the most abundant in fungi and is the strongest and most resistant isomer (Triunfo et al. 2021, Alimi et al. 2023). Chitin is a key structural component of fungal cell walls and septa, providing mechanical strength and rigidity.

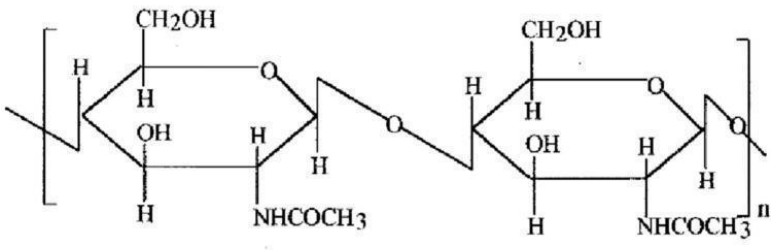


Fig. 227 – Chemical structure of chitin. Image credit: Alimi et al. (2023).

The abundance of chitin, along with proteins and glucans, plays a significant role in the mechanical strength and structural integrity of mycelium-based biomaterials (Amobonye et al. 2023). In addition, the deacetylated derivative of chitin, known as chitosan or glucosamine, is applied to prepare different materials, such as membranes, sponges, gels, scaffolds, nanoparticles, and nanofibers (Duan et al. 2018).

Circular economy

Circular economy is an economic model that aims to produce goods and services by minimising resource consumption and waste (Meyer et al. 2020, Alemu et al. 2022a). In contrast to the linear economy model, which follows a make-use-dispose approach, the circular economy model transforms waste into valuable resources. The overexploitation of natural resources and improper waste disposal are major contributors to pollution, posing a serious risk to ecosystems and human health (Alemu et al. 2022a). Mushroom mycelium-based biomaterials offer a sustainable alternative, as they are fully biodegradable and produced from lignocellulosic organic substrates (such as agricultural and forest byproducts), combined with mushroom mycelium (Khyaju & Luangharn 2024, Khyaju et al. 2026). These materials are promising candidates in transitioning a petroleum-based linear economy to a bio-based circular economy and reducing greenhouse gas emissions (Meyer et al. 2020). Notably, mycelium-based biomaterials can be composted after use, which ultimately contributes to ecological balance and resource regeneration.

Compressive strength Fig. 228

Compressive strength is the maximum stress a material or structure can withstand under compression or loads before failure. It is a key factor in determining the suitability of materials for packaging, construction, and engineering various applications. Compressive strength of mushroom mycelium-based biomaterials depends on the substrate type and the species of mushrooms used (Chan et al. 2021, Mardijanti et al. 2021). For mycelium-based biomaterials, compressive strength typically ranges from 0.03 to 4.44 MPa (Aiduang et al. 2022). Compressive strength is determined using standardised protocols, such as ASTM D3501, on an Instron 5900R load bench with a 100 kN capacity and a 10 kN static load cell under ambient conditions (25°C and ~50% RH) (Aiduang et al. 2022). The 10 kN load cell ensures precise results due to the expected low ultimate load values. The tests are conducted under displacement control at a rate of 5 mm/min. The resulting load-displacement data is then converted to a stress-strain curve, using the following formula to calculate compressive stress (σ) and strain (ε):

$$\sigma = \frac{F}{A}[MPa]$$

and,

$$\varepsilon = \frac{\Delta L}{Lo}[-]$$

where,

F = compressive force (N), A = original cross-section area of the specimen (mm^2), ΔL = displacement of the loading surfaces (mm), and L_o = original height of the test piece (mm).

Construction biomaterials Fig. 229

Construction biomaterials are innovative, sustainable, and eco-friendly materials derived from natural sources and designed for use in building and construction. They are increasingly popular due to their low environmental impact, biodegradability, and lower energy consumption and carbon emissions compared to traditional construction materials such as concrete, steel, and plastics. Biomaterials include a wide range of products, such as mushroom mycelium-based biomaterials, bamboo, hemp crates, and straw bales. They can be manufactured into bricks, blocks, and panels, primarily using natural lignocellulosic byproducts as the key components. Among

these, mycelium-based biomaterials, as construction products, exhibit lower brittleness and higher ductility than products without mycelium (Sharma & Sumbria 2022). Notably, they meet international standards for construction biomaterials, offering desirable properties such as physical and mechanical strength, thermal and acoustic insulation, and resistance to water and fire (Saez et al. 2021). However, these products require further research to enhance their strength and durability (Dessi-Olive 2019, Ozdemir et al. 2022).

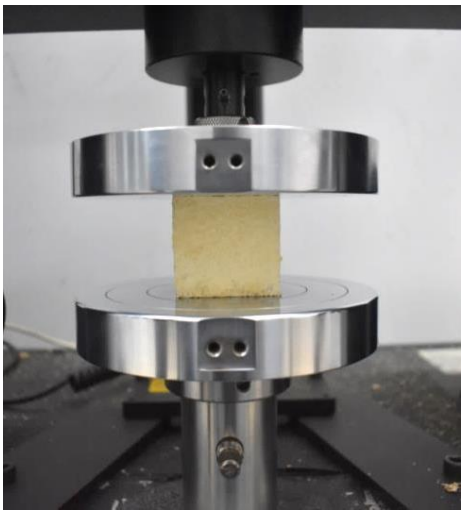


Fig. 228 – Compression strength test of mycelium-based biomaterial test sample.



Fig. 229 – Mushroom mycelium-based biomaterials as construction biomaterials.

Denaturation Fig. 230

Denaturation refers to the structural alteration of living materials, particularly proteins and nucleic acids (Dill & Shortle 1991). In mushroom mycelium-based biomaterials, this treatment is done after mycelium has fully colonised the substrate, by exposing it to a higher temperature for a specific duration. The heating conditions can vary, such as 90°C for 90 min or 90°C for 30 min, or 60°C for 48 hr (Ghazvinian et al. 2019, Ly & Jitjak 2022, Oral et al. 2022). This post-harvest treatment effectively kills the mycelium without any adverse effects on users of the final products. The heat-press treatment of mycelium-based biomaterials increases anastomosis among hyphae, resulting in greater bonding and strength. Notably, the higher temperature treatment removes almost all the moisture from the mycelium-based biomaterials and makes them rigid with increased mechanical strength.



Fig. 230 – Denaturation of mushroom mycelium-based biomaterials by drying in a hot-air oven.

Dry density

Dry density is a fundamental physical property defined as the ratio of mass to volume. It is calculated using the formula: D = m/v, where "D" is the dry density (kg/m^3), "m" is the dry mass of materials (kg), and "v" is the volume of the sample (m^3) (ISO 9427:2003, Elsacker et al. 2019).

In the context of mushroom mycelium-based biomaterials, density is a critical parameter that directly affects the material's mechanical performance, structural integrity, and potential applications. Density of mycelium-based biomaterials ranged between 25–954 kg/m^3, comparable to synthetic materials that range between 11–920 kg/m^3 (Jones et al. 2020, Aiduang et al. 2024). Several factors influence the density of mycelium-based biomaterials, including mushroom species used (e.g., *Ganoderma lucidum*, *Pleurotus ostreatus*, and *Trametes versicolor*), substrate type and substrate packing, growth conditions (e.g., relative humidity, temperature, moisture, and pH), post-processing techniques (e.g., pressing), and drying methods and conditions (Aiduang et al. 2024). These parameters can be fine-tuned to create mycelium materials with desired densities suited to specific applications such as packaging, acoustic insulation, composite panels, and eco-design products. Beyond their comparable densities, mycelium-based biomaterials offer key sustainability advantages over synthetic alternatives. They are biodegradable, low-cost, energy-efficient, and derived from renewable biological sources. This makes mycelium-based biomaterials a promising candidate for replacing petroleum-based materials in various industries (Khyaju & Luangharn 2024).

Ectomycorrhizal fungi Fig. 231

Ectomycorrhizal fungi are a group of fungi that form a mutualistic symbiotic association primarily with the roots of woody trees (Sharma 2017). These fungi develop a fungal sheath around the host plant's root and form a Hartig net, a network of hyphae that penetrates between root cortical cells to exchange nutrients. Through this relationship, the fungus receives plant-derived carbohydrates (mainly glucose), while the plant gains enhanced access to water and essential mineral nutrients such as Nitrogen and Phosphorus. Notable genera of ectomycorrhizal fungi include both edible and toxic species, such as *Amanita* Pers., *Boletus* L., and *Cantharellus* Adans. ex Fr., *Lactarius* Pers., *Russula* Pers., and *Tuber* P. Micheli ex F.H. Wigg. (Yun & Hall 2004).

While ectomycorrhizal fungi play vital ecological roles in forest ecosystems, they are less suitable for applications in mushroom mycelium-based biomaterials. This is primarily because they depend on living host trees for growth and are not easily cultivated on common agricultural or forestry byproducts (Yun & Hall 2004). In contrast, saprobic fungi, which decompose organic

matter independently, are preferred for mycelium-based biomaterial development due to their ease of cultivation, substrate flexibility, and ability to form dense, cohesive mycelial networks (Sydor et al. 2022).



Fig. 231 – *Thelephora* species, an ectomycorrhizal mushroom.

Elastic modulus

Elastic modulus, also known as modulus of elasticity, is a key mechanical property that measures the ability of a material to resist non-permanent (elastic) deformation under applied stress. It is defined as the slope of its stress-strain curve within the elastic deformation region. The elastic modulus is often determined by drawing a tangent to the steepest part of the force-displacement curve (Irbe et al. 2022). Based on its applications, mycelium is a biopolymer composed primarily of chitin microfibrils that play a central role in determining mechanical performance (Islam et al. 2017). The interconnected hyphal structure, formed through a process known as anastomosis (hyphal fusion), enhances the mechanical integrity and strength of the mycelium matrix (Glass et al. 2004).

In mushroom mycelium-based biomaterials, the elastic modulus is largely influenced by the filament elasticity, hyphal branching, and network density of the mycelium structure (Islam et al. 2017). Notably, the elastic modulus of mycelium is also affected by the variation in hyphal chemical composition of different fungal species (Haneef et al. 2017, Olivero et al. 2023).

Enzymatic degradation

Enzymatic degradation is the process in which enzymes break down complex molecules into simple forms. In nature, organic materials such as carbohydrates, proteins, and lipids are decomposed naturally by several decomposers, including bacteria, fungi, and soil organisms, and maintain the carbon cycle (Cragg et al. 2015). Among them, mushrooms release lignocellulolytic enzymes such as cellulases (endoglucanase, exoglucanase, glucosidase), hemicellulases (xylanase, mannanase, arabinase), and lignases (phenol oxidase, peroxidase) to degrade lignocellulosic substrates, followed by the utilisation of degraded materials to produce basidiomata (Kumla et al. 2020). The substrates are mainly composed of cellulose, lignin, and hemicellulose, which are degraded during solid-state fermentation by breaking glycosidic bonds (Sánchez 2009, Andlar et al. 2018, Kumla et al. 2020). These hydrolytic and oxidative enzymes released by mushrooms act on these complex biopolymers, breaking them down (Kumla et al. 2020). In the mushroom mycelium-based biomaterial development process, enzymatic degradation of the lignocellulosic substrate is an essential step from mycelium inoculation into the substrate to final denaturation. The complex mycelial network binds substrate particles, forming a dense mycelial layer (Khyaju & Luangharn 2024, Khyaju et al. 2026).

Fire resistance Fig. 232

Fire resistance is the ability of a material to withstand fire or high temperatures without igniting. Key factors influencing fire resistance include decomposition temperature, residual char formation, and the type of gases released during pyrolysis. Mushroom mycelium-based biomaterials have gained attention as promising candidates for fire-retardant applications, particularly in packaging and construction (Jones et al. 2018). The thermal stability of mycelium is enhanced by the conversion of chitin into chitosan through deacetylation, as well as the presence of hydroxyl-terminated polysaccharides that promote char formation (Chulikavit et al. 2023). The resulting char acts as an insulating barrier, reducing heat transfer and limiting fire propagation (Chulikavit et al. 2023). For instance, mycelium-based biomaterials have demonstrated that their fire resistance, compared to conventional thermoplastic polymers, is largely due to their higher char yield (Jones et al. 2018). However, a limitation of mycelium-based biomaterials is that its organic constituent releases heat, smoke, and gases during combustion, which can pose challenges in fire management (Mouritz & Gibson 2007, Jones et al. 2018). Nevertheless, incorporating fire-retardant materials, such as thermal protective coatings or sacrificial materials, can enhance fire resistance (Chulikavit et al. 2023). The elevated char yield signifies the potential of mycelium-based biomaterials as effective fire-resistant materials.



Fig. 232 – Fire resistance test showing char formation in the mushroom mycelium-based biomaterials.

Flexural strength Fig. 233

The flexural strength test, also known as the three-point bending test, is used to determine a material's flexural or bending properties. Flexural strength is the ability of a material to resist deformation under bending (Yang et al. 2021). The flexural strength test of mushroom mycelium-based biomaterials follows a standardised protocol, such as ASTM D7254, using a universal testing machine equipped with a three-point fixture (Aiduang et al. 2022). The apparatus has a cross-head speed of 2 mm/min and a clamp-support distance of 100 mm. Flexural strength is a crucial parameter for evaluating the suitability of mycelium-based biomaterials in applications such as packaging, construction, and insulation. Flexural strength values for mycelium-based biomaterials typically range from 0.05 to 4.44 MPa (Aiduang et al. 2022). Flexural strength of mycelium-based biomaterials depend upon factors, such as the type of hyphal system and the pressing method used (Appels et al. 2019).

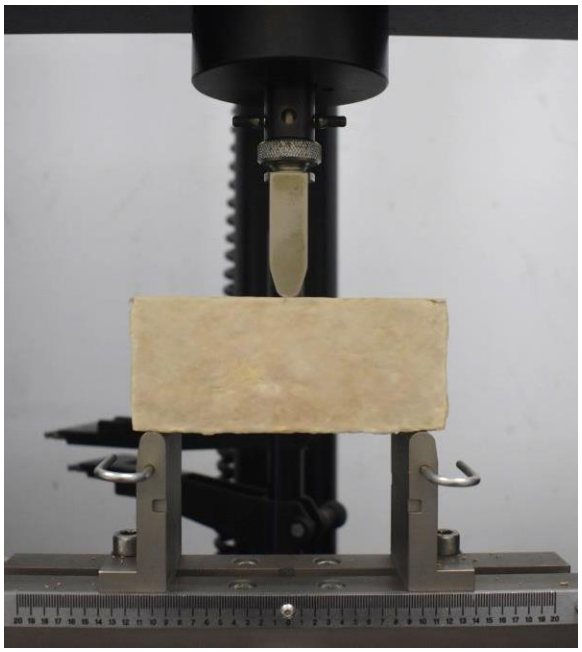


Fig. 233 – Flexural strength test of mushroom mycelium-based biomaterial.

Fourier Transform Infrared Spectroscopy Fig. 234

Fourier Transform Infrared Spectroscopy (FTIR) is an analytical technique used to obtain the infrared (IR) spectrum of absorption or emission of solid, liquid, or gas samples (Smith 2011). FTIR analysis is typically performed using Attenuated Reflectance Spectroscopy (ATR) and Transmission spectroscopy. In the ATR method, IR radiation enters a crystal material at a 45° incident angle and interacts between the crystal and the sample. The radiation penetrates the sample to a depth of approximately one micrometre, where some radiation is absorbed, while the remaining is reflected to a detector. In the transmission method, IR radiation passes directly through the sample, where a specific frequency of light is absorbed, and the unabsorbed radiation continues through the sample to a detector. In mushroom mycelium-based biomaterials, FTIR is used to analyse the mycelial chemical composition by scanning over a spectral range of 4000−400 cm^{-1} at a resolution of 1 cm^{-1} (Raman et al. 2022). The resulting FTIR spectra primarily reveal key functional groups, such as hydroxyl stretches, lipids, proteins, and polysaccharides.

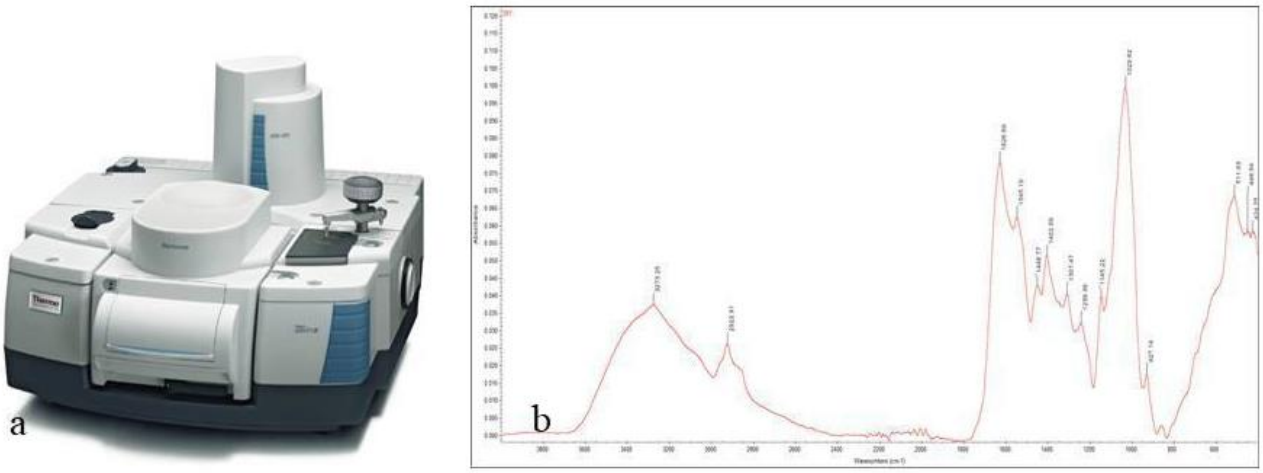


Fig. 234 – Fourier Transform Infrared Spectroscopy. a FTIR machine (Thermo Scientific Nicolet iS50 Ft-IR). b FTIR spectra.

Genome editing

Genome editing, also known as gene editing, refers to a set of techniques used to modify the DNA of living organisms. These techniques enable the addition, deletion, or alteration of specific genes within a chromosome. One of the most popular tools is clustered regularly interspaced short palindromic repeats associated system 9 (CRISPR-Cas9), which has applications across food, agriculture, and biotechnology (Eş et al. 2019). In fungi, genome editing has been used for the development of mushroom mycelium-based biomaterials. These biomaterials, valued for their sustainability and biodegradability, can now be enhanced at the genetic level to improve their physical and functional properties (Madusanka et al. 2024, Salichanh et al. 2025). Additionally, engineering *Ganoderma* species to express the β-1, 3-glucan synthases (BGS1 and BGS2) in *Ganoderma* led to a remarkable 135–165% increase in β-glucan, which is a key structural component of fungal cell walls (Vandelook et al. 2021, Madusanka et al. 2024, Salichanh et al. 2025). Furthermore, the deletion of the SC3 gene in *Schizophyllum commune* resulted in a significant increase in mycelium density, Young's modulus, and tensile strength compared to the wild type (Whabi et al. 2024). These genetic enhancements address some of the mechanical limitations traditionally associated with mycelium-based biomaterials. Thus, genome editing continues to unlock new possibilities in fungal biotechnology, paving the way for stronger, more functional, and more sustainable biomaterials.

Impact strength

The impact strength test is a method used to determine the impact resistance of materials. Impact strength refers to the ability of a material to withstand or resist sudden applied loads without breaking. During testing, samples are loaded in a testing machine and subjected to a known mass and length pendulum until fracture occurs. With this, the energy absorbed by a sample before breaking is measured. The two standard methods of impact strength testing are the Charpy and Izod impact methods. The impact strength test for mushroom mycelium-based biomaterials follows standardised protocols, such as ASTM D-256 for the Izod test method (Aiduang et al. 2022). The impact strength value is essential in assessing the suitability of mushroom mycelium-based biomaterials for applications such as packaging and construction.

Impact strength is calculated using the formula;

$$IS = \frac{K}{A}$$

where,

IS = Impact strength (kJ/m^2), K = Energy required to fracture the sample (kJ), and A = Cross-sectional area (m^2)

Lignocellulosic substrate Fig. 235

Lignocellulosic feedstocks—complex matrices of cellulose, hemicellulose, and lignin—originate from post-harvest agricultural residues and forest-processing by-products such as sawdust, rice husk, rice straw, hemp bast, sugarcane bagasse, maize stalks and husks, wheat straw, spent coffee grounds, and sorghum culms. Currently discarded or openly burned, these biomass streams are significant sources of environmental contamination. A scientifically grounded valorisation strategy is to employ these lignocellulosic fractions as nutrient-rich substrates for the controlled cultivation of filamentous basidiomycetes, thereby directing carbon and energy flows into the synthesis of mycelium-based biocomposites.

The selection of substrates is based on availability, nutritional content, degradability, cost, structural properties, and compatibility with mycelium (Etinosa 2019, Alemu et al. 2022b). Nutrient supplements, such as rice bran, molasses, and yeast extract, are incorporated to improve fungal growth conditions. Additionally, lime ($CaCO_3$) and gypsum ($CaSO_4 \cdot 2H_2O$) regulate the pH, creating an optimal environment for mycelial growth. Mycelium breaks down cellulose into glucose, with cellulose-rich substrates providing robust mycelium-based biomaterials. Substrate selection critically affects the physical and mechanical properties of the mycelium (Raman et al.

2022). The natural fibre within the substrate contributes to reinforcement, reducing shear failure risks in the final product (Yang et al. 2017c, Elsacker et al. 2020). Using the fibre-enriched substrates enhances the compression strength (570 kPa) and elastic modulus (60 MPa) of mycelium-based biomaterials (Yang et al. 2017c).



Fig. 235 – Lignocellulosic substrates. a Sawdust. b Rice husk. c Rice straw. d Coconut coirs.

Load-bearing capacity

Load-bearing capacity is defined as the maximum load a material can bear without failure. It is particularly related to the strength of the materials used in building and mechanical components, ensuring their safety and stability. It is influenced by key factors: density, strength, elasticity, shape, size, and environmental conditions. Mushroom mycelium-based biomaterials are sustainable and biodegradable materials that have been increasingly utilised in several fields, including construction, textiles, packaging, and architectural works (Khyaju & Luangharn 2024). Mycelium-based biomaterials are popular, innovative, and eco-friendly materials that fulfil material properties and are being utilised to overcome the issues inherent in plastic and foam-based products (Abhijith et al. 2018, Fairus et al. 2022). Previous studies have reported mycelium-based biomaterials properties as: density (25–954 kg/m^3), compressive strength (0.03–4.44 MPa), tensile strength (0.01–1.55 MPa), and flexural strength (0.05–4.40 MPa) (Aiduang et al. 2022). Mycelium-based biomaterial fulfils some of the properties of foam, plastic, and wood-based materials. Porter et al. (2023) recommended mushrooms with trimitic hyphal structure for higher mechanical strength over mushrooms with monomitic or dimitic hyphal systems. However, for the construction of large structures, it holds limitations and requires reinforcement systems (Dessi-Olive 2019, Ozdemir et al. 2022). Research on improving the overall properties of mycelium-based biomaterial is increasing mainly through substrate selection, species exploration, and method improvement.

Moisture content

Moisture content refers to the amount of water present within a substance. For mycelium-derived biomaterials, precise hydration governs critical processing stages: axenic culture initiation, spawn expansion, and the subsequent colonization of the lignocellulosic matrix by the filamentous hyphae. It provides turgor pressure to the hyphal tips, facilitating better penetration into substrates and promoting the elongation and extension of mycelia (Arijit et al. 2013, Nashiruddin et al. 2022). The ideal moisture content in the substrate ranges between 60–75%, and below 40% can result in slow and wispy mycelial growth (Stamets 2011). In contrast, excessive moisture content can lead to oxygen deficiency and nutrient leaching (Nashiruddin et al. 2022). Additionally, excessive moisture content increases the risk of disease development (Ryu et al. 2015). Insufficient or excessive moisture in the substrates can cause poor mycelium growth and lead to failure in cultivation.

The moisture content of a material is measured using the oven drying method or a moisture analyser. It is calculated following ISO 16979:2003 using the formula below:

$$MC\ (\%) = \frac{Ww - Wd}{Wd} \times 100\%$$

where,

MC = moisture content (%), W_w = wet weight (g), W_d = oven dry weight (g)

Moulding Fig. 236

Moulding refers to the technique of shaping materials by placing them into hollow containers, known as moulds or formworks. In mushroom mycelium-based biomaterial, this process involves breaking down a fully-grown mycelium-substrate mixture into fine particles under sterile conditions. Aseptic conditions are maintained by 70% ethanol (Attias et al. 2019). The mycelium-substrate mix particles are then transferred into moulds, where the mycelium grows and binds the substrate into a cohesive form (Abhijith et al. 2018). Plastic moulds are commonly preferred due to their ease of handling, durability, and ability to provide a wide range of shapes and sizes (Attias et al. 2019). During mycelial growth, the mycelial network interconnects substrate particles in multiple dimensions, forming a solid structure as per the design of the mould (Manan et al. 2021). After a few days to weeks, they are unmoulded, and the material is allowed further mycelial growth on the surface of the material attached to the walls of moulds.

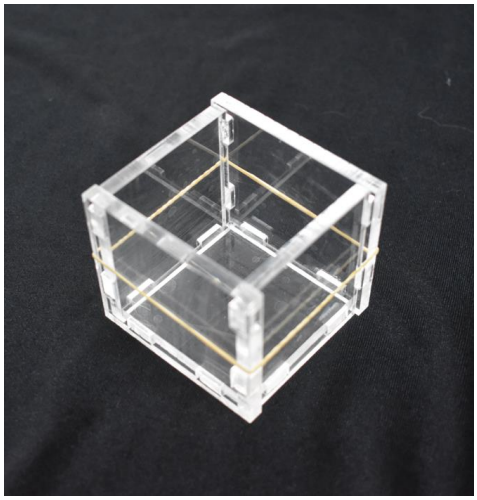


Fig. 236 – Acrylic cube mould used for test sample preparation.

Mushroom mycelium Fig. 237

Mycelium is the vegetative part of mushrooms, consisting of a mass of branching, thread-like, hollow, and tubular hyphae (Alemu et al. 2022a). It plays a vital role in decomposing organic matter through enzymatic activity and absorbing nutrients from the substrate to support fungal growth and development. In mycotechnological fabrication of sustainable, biodegradable composite materials, fungal mycelium serves as the load-bearing matrix. A selected basidiomycetous strain colonizes a lignocellulosic substrate—typically sterilized sawdust—where it elaborates an interwoven network of hyphae. The hyphal filaments secrete extracellular enzymes that partially depolymerize the lignocellulose, facilitating intimate mechanical interlocking between the fungal biomass and the substrate particles. After complete colonization, the composite is subjected to controlled dehydration or thermal treatment to inactivate metabolic activity, arrest further hyphal proliferation, and thermoset the matrix, thereby enhancing flexural modulus and compressive strength (Khyaju & Luangharn 2024). In addition to mycelium-based biomaterials, pure mycelium mats or mycelium leather can be produced by cultivating mycelium growth in liquid or solid media until the desired thickness and density are achieved, offering versatile applications in sustainable textiles and design.

Mushroom mycelium inoculation Fig. 238

Mushroom mycelium inoculation refers to the addition of mycelium, a vegetative part of a fungus, into a substrate, where it can grow and eventually produce basidiomata or fruiting bodies. Pure culture is prepared by isolating (spore or tissue) from basidiomata and sub-culturing them, which is then inoculated into the substrates in the form of liquid or solid spawn. This process is done in sterile conditions, such as under laminar flow. The increased inoculation rate accelerates

mycelial growth, reduces contamination, and significantly increases the yield (Stamets 2011). In the development process of mushroom mycelium-based biomaterials, liquid culture or grain spawn is introduced into the substrate and allowed to grow until full maturity, and then the mycelium-substrate mix is broken down and transferred into predesigned moulds (Khyaju & Luangharn 2024).



Fig. 237 – Mushroom mycelium in agar media.



Fig. 238 – Sawdust bag after mushroom mycelium inoculation.

Mushroom mycelium-based biomaterials Fig. 239

Mushroom mycelium-based biomaterials, or mycelium-based bio-composites, are innovative, sustainable, eco-friendly, and biodegradable alternatives to plastics and synthetic products. It is developed from the combination of mushroom mycelium and lignocellulosic substrates. Among the mushrooms, species of *Ganoderma* P. Karst., *Trametes* Fr., and *Pleurotus* (Fr.) P. Kumm. are the most widely utilised in the development of biomaterials (Aiduang et al. 2022). Mycelium acts as a binder, holding substrates together under suitable conditions of temperature, moisture, and pH. Agricultural and forest byproducts are the main lignocellulosic substrates for biomaterial development.

The substrates are enriched with nutrient supplements, including rice bran, molasses, lime, and gypsum. The mixture is autoclaved and then inoculated with mycelium spawn. The mycelium of the species is isolated and sub-cultured to develop a pure culture (Aiduang et al. 2022). Once the mycelium fully colonises the substrate and before pinning begins, it is dehydrated and treated to

produce the final mycelium-based biomaterials, which are applied in packaging, construction, architectural designs, textiles, and insulation (Khyaju & Luangharn 2024). Several leading companies, including Ecovative Design, Mycoworks Inc., and Mogu, are commercially producing mycelium-based biomaterials.

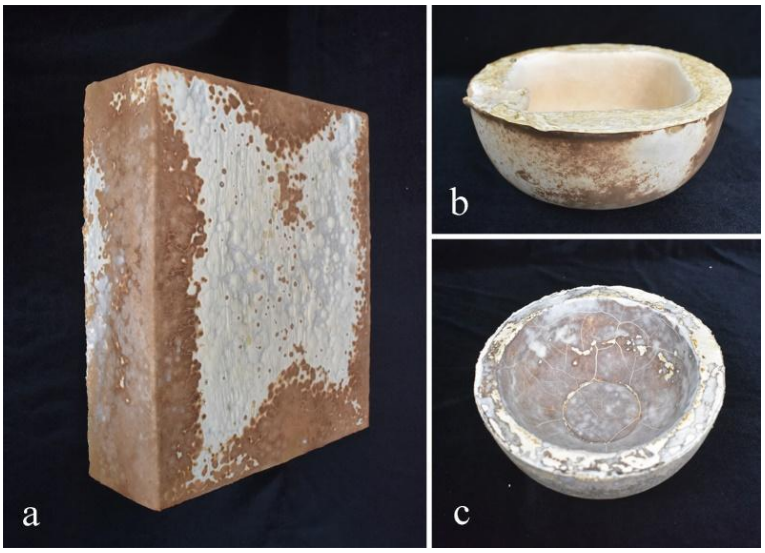


Fig. 239 – Mushroom mycelium-based biomaterials. a Construction block. b–c Container bowls.

Mushroom spawn Fig. 240

Spawn functions as a seed for transferring mycelium to a substrate for growing mushrooms. Spawns are typically prepared in the liquid, grain, or sawdust form for cultivating edible and medicinal mushrooms, such as *Agaricus bisporus*, *Lentinula edodes*, and *Pleurotus ostreatus*. The substrate is sterilised to kill the unwanted fungi and bacteria. A pure culture or mycelium, generally prepared in potato dextrose agar media, is then inoculated into the sterilised substrates. The inoculated substrate is incubated for mycelial growth at room temperature (25–30ºC) in the dark. During this process, the fungal hyphae develop an interconnected network that binds the discrete particles (Cerimi et al. 2019).



Fig. 240 – Grain (sorghum) spawn of a mushroom.

Spawn inoculation ratio exerts a decisive influence on both the colonisation interval and the initiation of primordia formation (Stamets 2011). Elevating the proportion of viable inoculum

accelerates radial hyphal expansion, thereby concomitantly suppressing the establishment of adventitious fungal contaminants. Sydor et al. (2022) have recommended using the optimum inoculum density of spawn to substrate to minimise the lag phase. Optimizing the spawn-preparation phase shortens the entire cultivation cycle and lowers production costs in the manufacture of fungal mycelium–based biomaterials, because high-quality spawn is a prerequisite for the subsequent mycelium–substrate formulation.

Mycelium anastomosis Fig. 241

Anastomosis refers to the random connection between two or more tubular or hollow structures within the same fungal species or between genetically similar species. In mushroom mycelium, the fusion of compatible hyphae results in a dense, fibrous vegetative structure known as mycelium (Islam et al. 2017, Patel & Sharma 2023). This hyphae fusion enhances nutrient distribution and allows signal exchange across the network. This phenomenon enabled fungal-based applications, including pure mycelium leather, packaging, tissue engineering, and innovations in fashion and designs (Patel & Sharma 2023). Additionally, the anastomosis technique has been utilised to develop new isolates or to improve the genetics of commercially cultivated edible mushroom species such as *Pleurotus florida* and *P. pulmonarius* (Samota & Sharma 2008, Adebayo et al. 2013, Farimani & Farsi 2023). During the production of mushroom mycelium-based biomaterial, anastomosis plays a key role in filling gaps between substrates and enhancing structural cohesion. This contributes to the formation of compact materials with improved physical strength, mechanical integrity, and durability (Patel & Sharma 2023, Ruggeri et al. 2023).

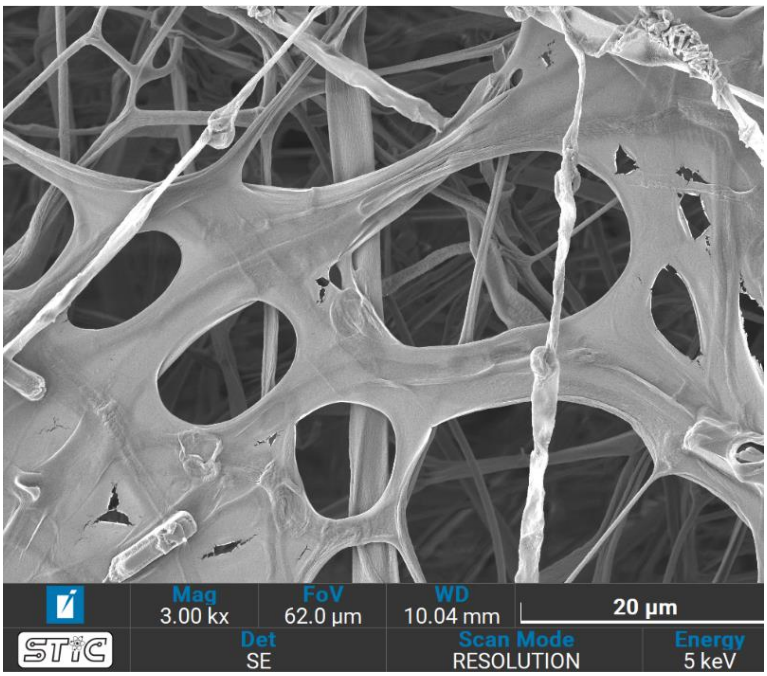


Fig. 241 – A representative SEM image of mycelium anastomosis of *Pleurotus ostreatus*.

Mycelium biocompatibility

Mycelium biocompatibility refers to the response of mycelium to direct interaction with human skin, as assessed using dermal fibroblasts (Antinori et al. 2021). Mycelium, the vegetative part of fungi, is a self-growing, biodegradable, and cost-effective material. The mycelial application in biomedical engineering is an innovative technique that can mimic the extracellular matrix of human tissues (Antinori et al. 2021). The function of the extracellular matrix is to provide physical support, communication pathways, and 3D organisation to the tissues (Frantz et al. 2010, Antinori et al. 2021). Mycelium secretes bioactive polysaccharides, such as chitin derivatives, which affect the growth of fibroblasts and keratinocytes (Antinori et al. 2021). Antinori et al. (2021) utilised

edible and medicinal mushroom species, *Pleurotus ostreatus* and *Ganoderma lucidum*, in growing a self-growing mycelium mat. Using the standard test ISO10993-5, the cytotoxicity effect of mycelium extract was assessed on primary human dermal fibroblast cells (Kossyvaki et al. 2020, Antinori et al. 2021). Ruggeri et al. (2023) conducted in-vitro characterisation of these two mushrooms for tissue engineering and reported them as biocompatible, safe, and effective enhancers in repairing tissue.

Mycelium colonisation Fig. 242

Mycelium colonisation is a natural process in which mycelium colonises a substrate after inoculation. During mycelial growth, its hyphae break down complex organic materials into simpler compounds, which can be absorbed through the mycelial walls. Mycelium expands with a dense network of hyphae and spreads throughout the substrates. In artificial mushroom cultivation, this process occurs in two stages: during spawn preparation and after inoculation into substrates. Optimal conditions for mycelial growth include a suitable temperature (20–30°C), moisture content (55–65%), proper ventilation, and dark conditions. To develop mushroom mycelium-based biomaterials, mushroom species with fast-growing, vigorous mycelium are preferred to reduce production time and costs. The mushroom hypha acts as a binding agent, integrating individual substrate particles to form a composite material that serves as the basis for mycelium-based biomaterial development (Jiang et al. 2016, Abhijith et al. 2018, Khyaju & Luangharn 2024).



Fig. 242 – Mycelium colonisation on a tree bark by a mushroom species.

Mycelium fermentation Fig. 243

Mycelium fermentation refers to the biotechnological process in which fungal mycelium breaks down and transforms organic substrates through metabolic activities under anaerobic conditions. There are four primary fermentation methods: liquid-state surface fermentation (LSSF), solid-state surface fermentation (SSSF), liquid-state submerged fermentation (LSF), and blended spawn-based fermentation (Singh et al. 2025).

In liquid-state surface fermentation, mycelium grows across the surface of a liquid medium, forming a cohesive mat at the air-liquid interface (Vandelook et al. 2021, Salichanh et al. 2025). Once matured, the mycelium mats are harvested, rinsed with reverse osmosis (RO) water to remove residual broth, and dried at 60°C for 48 hours or until dried weight becomes stable (Kniep et al. 2024). In solid-state surface fermentation, mycelium colonises and forms a thick layer over solid substrates under carefully controlled environmental parameters, typically at 25–30°C, 40–99% relative humidity, and 50,000–70,000 ppm carbon dioxide (Vandelook et al. 2021, Salichanh et al. 2025).

Liquid-state fermentation (LSF), also known as submerged fermentation, involves cultivating mycelium in nutrient-rich liquid media (e.g., potato dextrose broth, yeast malt dextrose broth, and blackstrap molasses), resulting in slurry or pelletized biomass (Singh et al. 2025). Solid-state

fermentation (SSF) is used to develop mushroom mycelium-based biomaterials. In this method, lignocellulosic substrates such as agricultural waste are colonised by fungal mycelium, which binds the individual together into composite materials. SSF offers numerous advantages, including increased productivity, less energy and water consumption, lower contamination risk, and minimum water wastage (Singh et al. 2025).

Mycelium growth kinetics

Mycelium growth kinetics refers to the temporal dynamics of mycelial growth, quantified by parameters such as mycelial growth rate, substrate type, mycelial biomass production, and metabolite production. Mycelium growth comprises four stages: the lag phase, the exponential (log) phase, the stationary phase, and the decline or death phase. During the lag phase, there is no visible mycelial growth, but metabolic activity begins. Pollack et al. (2008) reported a finite lag time in starved mycelium; during this period, vacuolar degradation produces sufficient endogenous carbon to support survival and the restart of hyphal extension. This phase can be observed during substrate bag preparation, where the amount of inoculated spawn has a direct relationship with mycelial growth; the optimal amount of spawn inoculation mitigates the lag phase. The exponential phase exhibits rapid hyphal elongation and branching, and the highest growth rate. The mycelial growth rate is affected by several environmental factors, including substrate type, temperature, moisture, and pH (Zervakis et al. 2001). For example, the mycelium of *Phlebiopsis friesii* (Lév.) Spirin & Miettinen exhibited the fastest growth rate in corn meal agar, followed by yeast malt agar, and the least in oat meal agar (Khyaju et al. 2025a). Similarly, in the substrate bag, the supplements boost the vigorous mycelial growth. With a decline in nutrients, mycelial growth becomes stationary. At the decline stage, mycelium starves as nutrients are depleted. In the development of mushroom mycelium-based biomaterials, mushrooms with fast mycelial growth rates and vigour are suitable for efficient production (Alemu et al. 2022a, Khyaju & Luangharn 2024). Additionally, the breakdown of the mycelium-substrate mix during mould fabrication triggers mycelial branching.



Fig. 243 – A representative image of liquid-state surface fermentation using mycelium of *Phlebiopsis friesii* in potato dextrose broth.

Mycelium living architecture

Mycelium living architecture is an innovative approach that utilises mushroom mycelium as a structural and living building material. Mycelium is the vegetative part of fungi, composed of filamentous hyphae, and works as a natural binding agent (Khyaju & Luangharn 2024). The versatile mycelium is allowed to grow on lignocellulosic substrates (such as sawdust, rice straw,

corn stalk, cotton fibres, hemp fibres, and coconut coir) and form a rigid composite, provided with a predesigned frame or mould. Several fungal genera utilised in this purpose include mainly *Ganoderma* P. Karst., *Trametes* Fr., and *Pleurotus* (Fr.) P. Kumm. (Aiduang et al. 2022, Khyaju & Luangharn 2024). The final material is composed of living mycelium, unlike traditional materials used in architecture. The discrete fungal-derived building elements are subsequently assembled into the desired macroscopic architecture. Notably, the constituent mycelium-based biocomposites are intrinsically biodegradable; upon completion of their service life, they can be subjected to controlled composting, yielding no residual xenobiotic contaminants.

The concept of utilising mushroom mycelium-based biomaterial in design and architectural works addresses environmental pollution, a critical concern associated with plastic and foam-based materials (Oral et al. 2022, Khyaju & Luangharn 2024). The concept is successful as several projects have been built and exhibited using mycelium-based biomaterials, including the Growing Pavilion, Hy-fi tower, Mycotree pavilion, Shell mycelium, Mycostructural Alpha, My-co space, and EI Monolito (Almpani-Lekka et al. 2021, Modanloo et al. 2021, Khyaju & Luangharn 2024). Currently, several fungal genera, substrates, and growth conditions are being investigated to produce superior-quality materials for mycelium-based biomaterial production. This indicates the expansion of mycelium-based biomaterials in the construction and architectural design sectors due to their eco-friendly and sustainable aspects.

Mycelium-based leather Fig. 244

Mushroom mycelium-based leather, also known as mycelium leather, is a sustainable, eco-friendly, and biodegradable alternative to animal or synthetic leather (Vandelook et al. 2021, Raman et al. 2022). It is produced by cultivating mycelium in lignocellulosic agricultural byproducts or synthetic nutrient media (Cartabia et al. 2021). Mycelium-based leather can be manufactured in a relatively small space and within a short time frame (weeks to months), emitting significantly fewer greenhouse gases than animal-based leather. Its production does not involve animal slaughter and requires fewer chemicals than conventional animal-based leather processing. Several commercial companies, such as Bolt Threads, MycoWorks, and Ecovative, are developing mycelium-based leather on an industrial scale. This innovative material has been applied in the fashion industry, biomedical scaffolds, textiles, and electronic components (Khamrai et al. 2018, Vasquez & Vega 2019, Antinori et al. 2021, Gandia et al. 2021, Danninger et al. 2022).

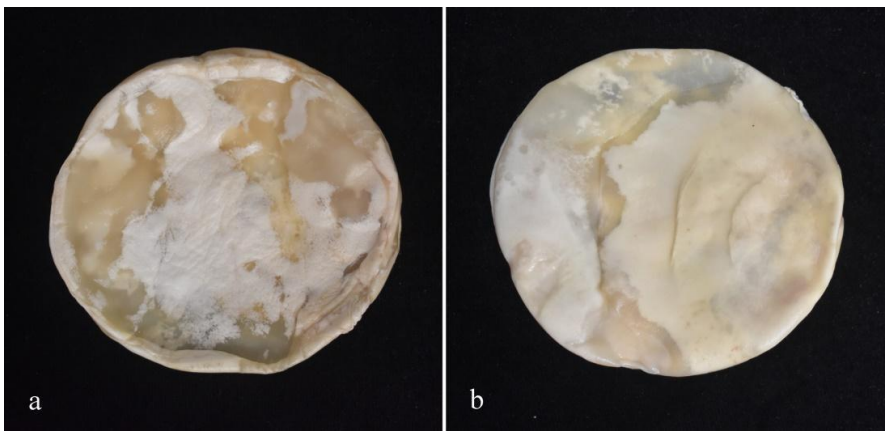


Fig. 244 – Representative mushroom mycelium-based leather. a Top view. b Bottom view.

Porosity Fig. 245

Porosity is the percentage of voids within a material, expressed as the ratio of void volume to the total volume in a material. It is an important parameter in the hydrodynamic characterisation of a material. The porosity of mushroom mycelium-based biomaterials depends on several factors, such as fungal species, growth conditions, substrate type, and post-harvest treatments. In mycelium-based biomaterials, porosity is estimated using scanning electron microscopy images by

calculating the total pore area (Olivero et al. 2023). Mercury intrusion porosimetry is another technique used with pressure at 0.0136 MPa and increased up to 200 MPa at the rate of 6–14 MPa min^{-1} (Antinori et al. 2020).

The porosity of mycelium-based biomaterials plays a significant role in determining material properties, including density, mechanical strength, water absorption, and sound absorption. This information provides guidance in the selection of mycelium-based biomaterials for specific applications, including packaging, insulation, filtration, and biomedical uses. High porosity is directly correlated to increased water absorption capacity, while it is inversely related to material density and mechanical strength (Antinori et al. 2020). For instance, heat or cold pressing of harvested mycelium-based biomaterials results in denser materials with low porosity (Manan et al. 2021). Notably, porous materials are also valuable in biomedical applications, such as drug delivery and tissue engineering (Antinori et al. 2020).

Renewable materials

The term "renewable" refers to resources that never end due to their replenishing nature, such as wood, wool, and solar energy. Mycelium, one among them, is a renewable root-like filamentous vegetative structure derived from mushrooms. It grows on a wide range of substrates and acts as a saprobe, pathogen, or ectomycorrhizal. Mycelium is the key component in mushroom mycelium-based biomaterial development that binds discrete substrates, especially lignocellulosic byproducts, to form a rigid composite (Fairus et al. 2022). Some commonly used renewable substrates in mycelium-based biomaterials include sawdust, coconut coir, hemp fibre, rice straw, corn stalk, and coffee wastes. Mycelium-based biomaterials are innovative and popular materials due to their renewable, biodegradable, and environmentally safe characteristics (Khyaju & Luangharn 2024, Khyaju et al. 2026). Mycelium-based biomaterials align with the principles of the circular economy and are biodegradable, which can be composted, ultimately serving as fertilisers to plants. Additionally, they are low-cost and low-energy-requiring materials that can be an alternative to the synthetic, non-renewable, and polluting petroleum-based plastic materials (Jiang et al. 2017, Fairus et al. 2022). Recently, these materials have been produced at an industrial scale and have a wide range of applications, including packaging, construction, leather, insulation, and architectural designs (Khyaju & Luangharn 2024).

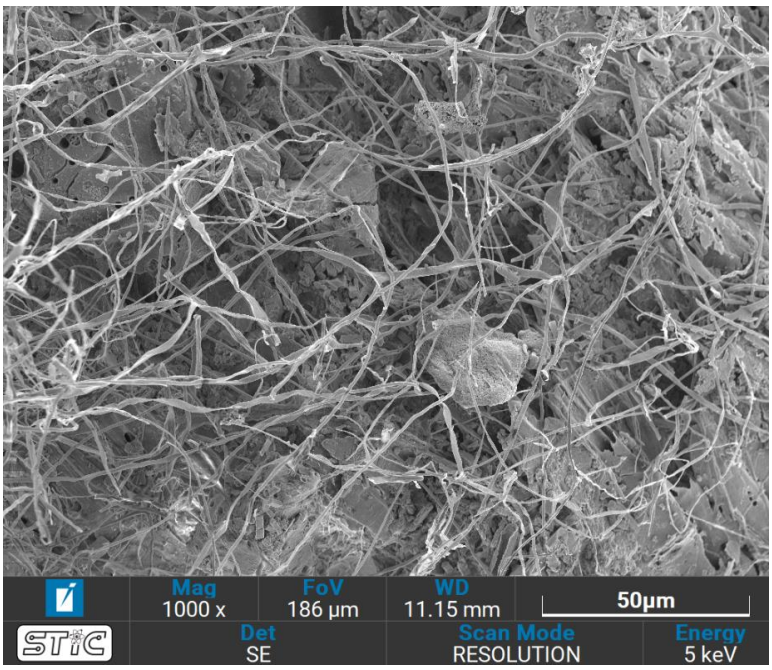


Fig. 245 – A representative SEM image of MMB developed from the mycelium of *Ganoderma tropicum* and sawdust showing porous properties.

Saprophytic mushroom Fig. 246

Saprophytic mushrooms, or saprobes, are fungi that thrive on dead or decaying organic materials such as fallen trees, straws, sawdust, and leaf litter. Some popular saprobic mushroom genera are *Agaricus*, *Auricularia*, *Coprinus*, *Fomes*, *Ganoderma*, *Lentinus*, *Lentinula*, *Mycena*, *Panus*, *Pleurotus*, *Schizophyllum*, and *Trametes*. These fungi release enzymes that break down complex organic materials, primarily lignin, cellulose, or hemicellulose, into a simple soluble form that can be absorbed (Raman et al. 2022). These mushrooms play a significant role in maintaining ecological balance and supporting nutrient cycling, particularly for key elements like nitrogen and carbon. In the natural habitat, these mushrooms exist in a vegetative form known as mycelium, producing a reproductive form as basidiomata (Raman et al. 2022). In developing mushroom mycelium-based biomaterial, only saprophytic mushrooms are utilised due to their capacity to grow under artificial conditions (Sydor et al. 2022). Among the various saprophytic species, *Ganoderma*, *Trametes*, and *Pleurotus* are most commonly used in mycelium-based biomaterial production (Khyaju & Luangharn 2024). The medicinal properties of *Ganoderma* spp. might contribute to increasing benefits to the products (Raut et al. 2022). Additionally, pure mycelium leather has been successfully produced by cultivating saprophytic mushroom mycelium in nutrient broths, paste, or solid substrates, providing optimal environmental conditions (Amobonye et al. 2023).



Fig. 246 – *Echinochaete thailandica*, a saprophytic mushroom, growing on a dead tree stump. Photo credit: Khyaju et al. (2025b).

Scaling up

Scaling up refers to the expansion of capacity in any field, such as research, technology, and business. Currently, the research and development of mushroom mycelium-based biomaterials are in their early stages, with a limited number of products being commercially produced (Bitting et al. 2022, Khyaju et al. 2025c). This slow progress might be attributed to their relatively low mechanical properties, the absence of standard production methods, and insufficient characterisation (Bitting et al. 2022). However, the mycelium-based biomaterials have been applied in several fields, including packaging, construction, architectural design, insulation, and textiles (Khyaju & Luangharn 2024). Mycelium-based biomaterials are sustainable, eco-friendly, and biodegradable materials that align with the principles of the circular economy. The awareness of people about environmentally safer materials is increasing steadily. Consequently, the demand for mycelium-based biomaterials, as alternatives to expanded polystyrene and foam products, is growing (Almpani-Lekka et al. 2021, Dessi-Olive 2022). Several companies, including Ecovative, Mycoworks, Mycotech, Bolt Threads, Adidas, Hermes, Lululemon, and Stella McCartney, have already introduced mycelium-based biomaterial products to the market (Vandelook et al. 2021).

Notably, significant research is needed to adapt mycelium-based biomaterial production technologies for industrial use.

Scanning Electron Microscopy Fig. 247

Scanning Electron Microscopy (SEM) is a highly effective imaging technique used to study the surface topography and composition of materials at high resolution, with a range of 1 µm to 1 nm (Vernon-Parry 2000). SEM is a widely used tool across several fields, such as material science, biology, and geology. The first SEM was developed based on the work of two physicians, Ruska and Knoll. In 1937, a high-resolution SEM was invented by Manfred von Ardenne (von Ardenne 1939, Mohammed & Abdullah 2018). SEM produces detailed images of a sample by scanning its surface with a focused electron beam of energy 2–40 keV (Vernon-Parry 2000). The electrons interact with atoms in the samples, producing various signals related to the topography of the sample surface. Currently, three types of SEM are popular: conventional SEM, environmental SEM, and low vacuum SEM (Mohammed & Abdullah 2018). The key components of SEM are an electron gun, a column, a deflection system with scan coils, detectors for backscattered and secondary electrons, a sample chamber, and a computer system to control the instrument and observe scanned images (Mohammed & Abdullah 2018).

In the study of mushroom mycelium-based biomaterials, a small sample piece is cut and mounted onto a stub adapter using double-sided carbon tape, and coated with gold for 2 min under high vacuum mode (Aiduang et al. 2022). The sample is then photographed using an SEM microscope at an accelerating voltage of 5 kV to analyse the arrangements of hyphae, voids, and substrate on the sample.

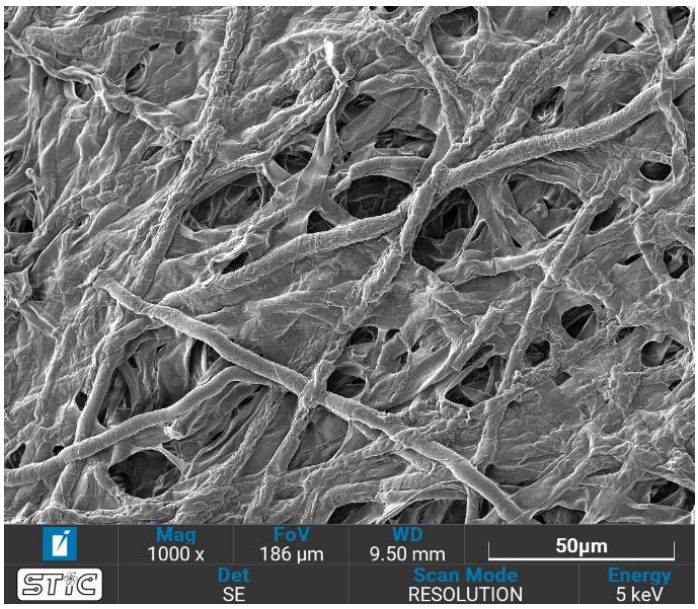


Fig. 247 – Scanning Electron Microscopy image of a pure mycelium mat.

Soil enrichment Fig. 248

Soil enrichment is defined as the process of enhancing soil quality by adjusting soil fertility, pH, organic matter content, and beneficial microorganism composition. In the mushroom mycelium-based biomaterials sector, the end product, such as packaging materials, after utilisation, can be broken down and composted. Mycelium-based biomaterials represent highly biodegradable alternatives to plastic and foam-based materials (Aiduang et al. 2022, Fairus et al. 2022, Khyaju et al. 2025c). Compost works as a fertiliser or soil supplement to improve soil porosity, organic matter, and nutrient content. The final mycelium-based biomaterial products are in a partially fermented state, in which the complex components continue the decomposition phase (Ghazvinian & Gursoy 2022). Upon incorporation into soil, these materials interact with soil microorganisms to

enhance the soil porosity. Also, they are rich in nutrients, providing beneficial materials for plants. Previous studies have reported nitrogen content and pH of the final mycelium-based biomaterials as 0.5–1.6% and 4.3–6.5, respectively (Aiduang et al. 2022). Aiduang et al. (2022) reported the water absorption potential of final mycelium-based biomaterials as 24.45–560%. This potentiality has a positive impact on the retention of moisture in the soil, thereby favouring the rhizosphere environment.



Fig. 248 – Biodegradation process of mycelium-based biomaterials into soil enrichment supplements.

Sterilisation Fig. 249

Sterilisation refers to the process of removing or killing microorganisms (fungi, bacteria, and viruses) from materials or media. Disinfection of a material can be done by several methods, such as using moist heat sterilisation (autoclaving), dry heat sterilisation (hot air oven), chemical sterilisation, and irradiation sterilisation (Harrington et al. 2020). However, the sterilisation technique can influence the intrinsic properties of materials such as 3D printing inks (Shyam & Palaniappan 2023). Effectiveness of sterilisation is affected by several factors, including material cleanliness, nature and extent of initial bio-burden, design of device, material chemical reactivity, and internal porosity (Harrington et al. 2020).



Fig. 249 – An autoclaving machine used to sterilise substrate bags in mushroom cultivation.

In mushroom mycelium-based biomaterials, the absence of microorganisms, from mycelium culture to final product, allows successful development of biomaterials. Sterile conditions are a fundamental requirement in mycelium culture, spawn, mycelium inoculated bags, fabrication in mould, and final mycelium growth. For example, PDA media is sterilised at 121°C for 15 min in an

autoclave. Sorghum grains for spawn are sterilised by autoclaving at 121°C for 30 min before mycelium inoculation. Lignocellulosic substrates (sawdust, rice straw, corn stalk, and hemp fibre) are autoclaved at 121°C for 60 min before inoculation of mycelium.

Sustainability

The concept of "sustainability" was first introduced by a German forester, Hans Carl von Carlowitz, in 1712 in his work *Sylvicultura Oeconomica*, where he outlined methods for managing forests to ensure their long-term viability (Scoones 2007). This concept focuses on the importance of collective efforts to conserve natural resources for future generations while balancing developmental activities. The World Commission on Environment and Development (WCED 1987) later defined sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs". Sustainable materials generate minimal pollution and waste throughout their lifecycle, including production, use, transportation, and disposal (Alemu et al. 2022a).

Plastics, traditionally derived from non-renewable petroleum-based resources, are widely used but pose significant environmental challenges due to their non-degradable nature and persistent pollution. Numerous initiatives have been introduced at both national and international levels to address this issue. Mushroom mycelium-based biomaterials have emerged as a promising alternative. These materials are eco-friendly, biodegradable, cost-effective, and energy-efficient, aligning with the principles of the circular economy (Jones et al. 2020, Alemu et al. 2022a, Khyaju et al. 2025c, Khyaju et al. 2026). Mycelium, the root-like structure of fungi, can be cultivated on a large scale in the laboratory and used as inoculum in agricultural and forest-based substrates. The mycelium-based biomaterials have been developed for diverse applications, including packaging, construction, insulation, textiles, and architectural designs, offering a sustainable alternative to conventional plastics.

Tensile strength Fig. 250

Tensile strength is a mechanical property that measures the maximum stress a material can withstand while being stretched before failure. In testing, standard samples are clamped within a universal testing machine (UTM) and subjected to uniaxial tension at a controlled strain rate. The resulting stress-strain relationship is plotted as a graph. These results provide information on structural integrity, elastic behaviour, and suitability for application. It is important to confirm the results to meet international standards such as the International Organization for Standardisation (ISO) and the American Society for Testing and Materials (ASTM) standards. For mushroom mycelium-based biomaterials, tensile strength evaluation is determined by an established standard protocol, such as ASTM D 638-14, with an elongation rate of 2 mm min^{-1} and a maximum load capacity of 1 kN under controlled temperature and humidity conditions (Appels et al. 2019). The main factors influencing tensile strength in mycelium-based biomaterials include mycelium strain, substrate composition, hyphal network density, and post-harvest processing treatments. Recent studies, such as Aiduang et al. (2022), reported the tensile strength values for mycelium-based biomaterials ranging from 0.01 to 1.55 MPa.

Thermal insulation

Thermal insulation refers to the process of reducing heat transfer between the environment and objects, thereby minimising energy consumption (Al-Qahtani et al. 2023). This technology is widely applied in buildings, clothing, vehicles, and electrical appliances to enhance energy efficiency. Conventional insulation materials, such as polystyrene foams, are commonly used due to their high insulating performance (Sulong et al. 2019, Tsao 2020). However, upon disposal, it poses significant environmental and health risks, including pollution and harming wildlife and humans. As a sustainable alternative, mushroom mycelium-based biomaterials have emerged as innovative, lightweight, porous, and eco-friendly materials that exhibit satisfactory thermal insulation properties (Elsacker et al. 2021, Alemu et al. 2022a, Al-Qahtani et al. 2023, Khyaju &

Luangharn 2024). Mycelium-based biomaterials exhibit a thermal conductivity ranging from 0.04–0.13 $W.m^{-1}.K^{-1}$, which is comparable to that of conventional foams with 0.03–0.04 ($W.m^{-1}.K^{-1}$) (Tsao 2020). This inherent insulation capability makes mycelium-based biomaterials suitable for various applications, particularly in the development of fire-retardant construction products, such as Greensulate (Abhijith et al. 2018).

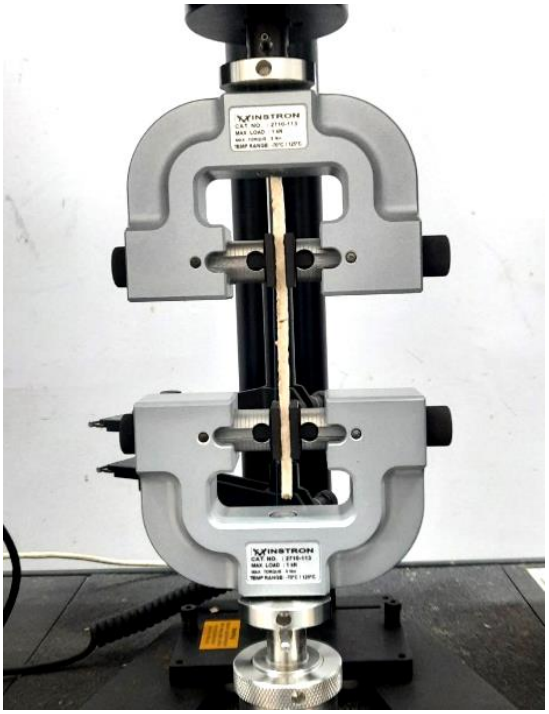


Fig. 250 – Tensile strength testing of mushroom mycelium-based biomaterial.

Thermal pressing Fig. 251

Thermal pressing is a fabrication technique conducted at room or elevated temperatures to produce dense, homogenised materials in desired shapes (Appels 2020). This method is applied to various materials, including plastics, polymers, ceramics, metals, wood products, electronics, and composite materials. In mushroom mycelium-based biomaterials, once the substrates are fully colonised by mycelium, they are harvested and dried to halt mycelial growth and remove moisture. The dried material is placed between heated plates or moulds and subjected to a hydraulic press at varying pressure and temperature conditions. For instance, this process is carried out at 150°C for 20 min under a pressure below 30 kN (Appels et al. 2019, 2020). The material can cool down under pressure to maintain the new shape. Treating mycelium-based biomaterials by hot-pressing increases their density and compressive strength by 2–3 times more than cold-pressing (Appels et al. 2019). It also improves mechanical properties such as tensile strength, flexural strength, stiffness, and elasticity (Appels 2020, Shakir et al. 2020). Additionally, the heat-compressed materials develop a brownish appearance, which might be due to the Maillard reaction, caramelisation, and pyrolysis of organic material (Powrie et al. 1986, Appels et al. 2019). The final products are utilised in several fields, including packaging, insulation, and construction.

Thermogravimetric analysis Fig. 252

Thermogravimetric analysis (TGA) is a technique to measure the mass change of a substance as it is exposed to controlled temperature and atmospheric conditions. It is an essential tool used to investigate thermal stability and compositional properties. When testing mushroom mycelium-based biomaterials, a sample weighing 5–10 mg is heated from 25°C to 900°C at a scanning rate of 20°C min^{-1} with a nitrogen flow of 25 ml min^{-1} (Cartabia et al. 2021). The resulting TGA curves reveal the distinct mass loss stages corresponding to its main components, such as chitin and beta-

glucan content. Additionally, the first derivatives of these curves (DTGA) are used to identify the decomposition temperature of the peaks as well as the start and end of the decomposition process (Cartabia et al. 2021).

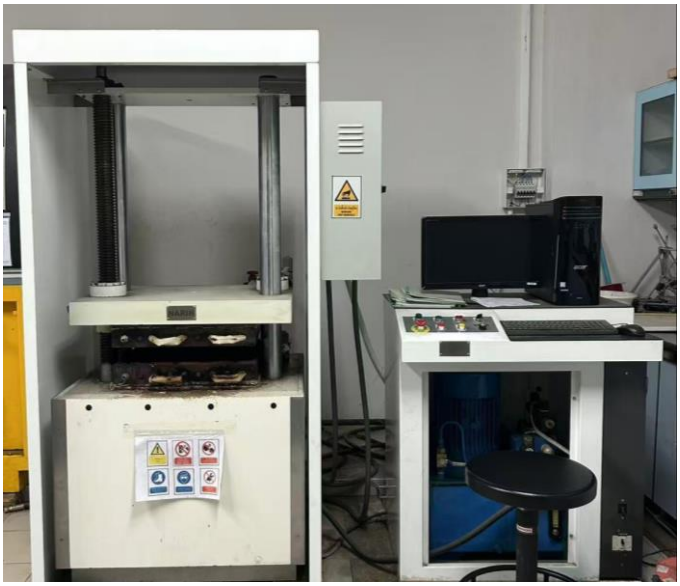


Fig. 251 – Thermal pressing machine set-up.

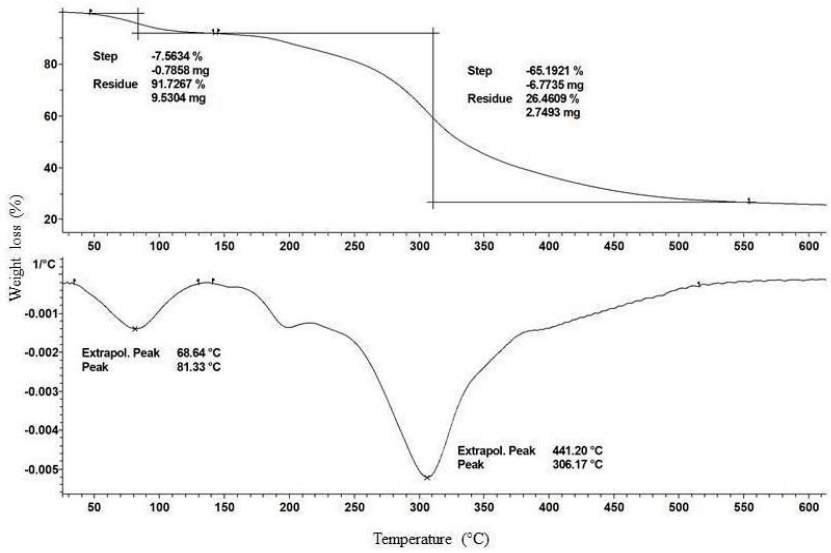


Fig. 252 – Thermogravimetric analysis (TGA and DTGA curves) of a mushroom mycelium-based biomaterial.

Waste valorization

Waste valorisation refers to the transformation of waste materials into valuable products for economic and environmental benefits. In the production of mushroom mycelium-based biomaterials, a variety of agricultural, forestry, and industrial residues such as sawdust, straw, husks, and fibres are utilised as substrates. Conventionally, such lignocellulosic byproducts are incinerated or discarded, contributing to greenhouse gases, particularly carbon dioxide, and causing global environmental pollution (Peydayesh 2024). These materials, which are rich in cellulose, hemicellulose, lignin, and chitin, serve as nutrients for the growth of mushroom mycelium (Aiduang et al. 2022). Mycelium-based biomaterials have emerged as innovative and sustainable materials with diverse applications in packaging, architectural designs, building insulation, and

textiles (Khyaju & Luangharn 2024). In this approach, mushroom specimens harvested from the forest are isolated to prepare a pure culture, and subsequently inoculated into the sterilised substrates. *Ganoderma*, *Pleurotus*, and *Trametes* are widely used mushroom genera (Khyaju & Luangharn 2024). This approach to waste valorisation through mycelium-based biomaterials follows the principles of the circular economy model, providing multiple benefits, including reducing lignocellulosic waste, promoting the utilisation of mushroom mycelium, reducing production cost, and developing economically valuable products (Peydayesh 2024).

Water absorption rate

Water absorption is defined as the movement of water into porous media without any external pressure. This test is performed by measuring the increment in the mass of a sample resulting from water absorption as a function of time when only one surface of the sample is exposed to water (ASTM C1585). It depends on the key factors, including surface energy, surface tension, capillarity, and material absorptivity (Nolan 1997). The rate of water absorption is measured by applying the ASTM C1585–04 standard for Hydraulic-Cement Concretes to partially submerged samples of mycelium-based biomaterials (ASTM C1585). The tests are conducted at room temperature (25°C, RH = 50%). Mushroom mycelium-based biomaterials are hygroscopic materials that exhibit higher water absorption capability, ranging from 24.45–560% (Jones et al. 2020, Aiduang et al. 2022). The water absorption is affected by the density of mycelium-based biomaterials, with lower absorption in higher-density materials due to reduced voids or pores (Tacer-Caba et al. 2020, Aiduang et al. 2022). Additionally, it is influenced by the cellulose component of the materials, which is composed of hydroxyl groups that characterise either hydrophobic or hydrophilic behaviour (Aiduang et al. 2022).

For mycelium-based biomaterials samples, the water absorption is determined from the weight difference from the initial weight using the following formula;

$$m = \frac{M_t}{a \times d}$$

where,

m = water absorption (mm), M_t = changed weight of the sample (g), a = the exposed cross section area (mm^2), d = the density of the water (g/mm^3).

Water contact angle Fig. 253

The water contact angle is a parameter to assess the wettability of solid surfaces by water (Antinori et al. 2021). It is defined as the angle between the tangent to a water droplet at the point of contact and the solid surface. A contact angle goniometer measures the water contact angle of test samples under static conditions at room temperature. During this process, a 5 µl droplet of de-ionised water is placed on the sample surface, and side-view images of the droplet are captured after 10 or 60 seconds. Surfaces with water contact angle less than 90º are classified as hydrophilic, those with a water contact angle greater than 90º as hydrophobic, and those exceeding 150º as super-hydrophobic. The hydrophobicity is related to specific proteins (hydrophobins and mannoproteins) in the outer cell wall of mycelium (Nussbaumer et al. 2023). Surface treatments or coatings, such as those applied to mushroom mycelium-based biomaterials using glycerol, tannic acid, or hot-pressed, can enhance the water contact angle and increase hydrophobicity. A higher water contact angle is generally desirable for materials, as it often correlates with a longer product shelf life. The relationship between the contact angle and surface energy is described by Young's equation as;

$$\gamma^{sv} = \gamma^{sl} + \gamma^{lv} Cos\theta$$

where,

γ^{sv} = surface tension of the solid-vapour interface

γ^{sl} = surface tension of the solid-liquid interface

γ^{lv} = surface tension of the liquid-vapour interface

θ = contact angle

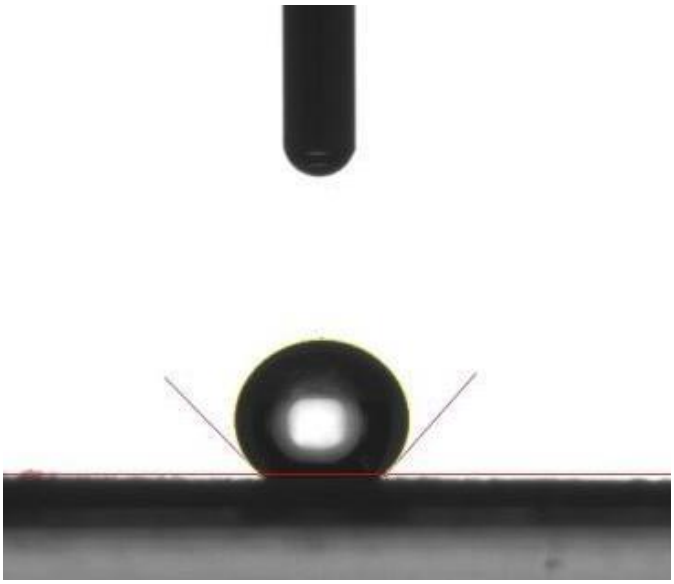


Fig. 253 – Water contact angle measurement of mushroom mycelium-based biomaterials.

Discussion

This study integrates the most recent scientific literature to provide critical insights into each fungal taxon. As the majority of the genera investigated fall within the *Agaricales*, this order serves as a focal point for understanding patterns of ecological diversity and morphological evolution. Following *Agaricales*, the orders *Boletales* and *Polyporales* represent the second and third most prevalent groups, respectively. To ensure objectivity and minimize selection bias, the taxa were selected independently of specific taxonomic or ecological preferences. This unbiased approach facilitates a comprehensive assessment of the latent potential within diverse fungal species for biomaterial engineering, rather than focusing exclusively on genera already established in the production of mycelium-based composites. Furthermore, by emphasizing taxa described before 2008, this research consolidates overlooked or under-documented information, evaluating its relevance and potential within the context of contemporary applied mycology.

Highlights of the taxonomic notes from this study

1. *Agaricales* encompasses a diverse range of habitats, including ectomycorrhizal, parasitic, and wood-decaying saprotrophs, and this ecological diversification is also reflected in the transitions in various basidiome forms. Within *Agaricales*, *Agaricaceae* sets a clear example of morphological evolution. It includes agaricoid, secotioid, and gasteroid taxa, showing shifts toward enclosed or partially enclosed fruiting bodies. Such transitions are mostly regarded as adaptive responses to environmental stress. For example, *Dictyocephalos* has hypogeous basidiomata with a powdery gleba that likely facilitates passive spore dispersal in dry habitats.

2. This study highlights the placement of *Melanophyllum* in the *Lepiota* clade, forming a monophyletic relationship with *Cystolepiota* and *Smithiomyces*. *Smithiomyces* is characterized by its fragmentary veil, which was long considered geographically restricted. However, records from China (Ge et al. 2021) indicate that the genus is more widely distributed across the Neotropics and tropical Asia. These findings highlight the limitations of morphology data and the importance of molecular data to confirm generic boundaries and monophyly within *Agaricaceae*.

3. Note on *Clavariaceae* shows how phylogenetics has reshaped its traditional taxonomic concepts. Once limited to clavarioid fungi, it now accommodates agaricoid genera such as *Hodophilus* and *Camarophyllopsis*. The transfer of *Hodophilus foetens* from *Camarophyllopsis* to *Hodophilus*, supported by both its camphor-like odour and LSU sequence data, reflects the integration of chemical characters and molecular evidence in modern fungal taxonomy.

4. The inclusion of *Nanstelocephala* to *Crepidotaceae* is also notable, as it represents a rare monotypic genus known only from dead branches in the USA. Without molecular data, its separation from morphologically similar genera such as *Pellidiscus* and *Physalacria* was uncertain. This highlights the challenges to resolve sequence-lacking taxa and emphasizes the need for more sampling.

5. Another important order, *Polyporales* consists of a diverse form of fungal basidiomata, including bracket-shaped, effused resupinate, stipitate, poroid, lamellate, labyrinthiform, or smooth hymenophore. They are mainly saprotrophic wood-decaying fungi, while some are plant pathogenic. Members of this group can produce either white-rot or brown-rot and regulate nutrient cycling.

6. Phylogenetically, *Polyporales* form a strongly supported clade within Agaricomycetes. Multigene molecular analyses have provided clarity in the position of several genera. For instance, the placement of genus *Rhodonia* has been accepted in a new family *Adustosporiaceae*, and *Ryvardenia* to *Laricifomitaceae*.

7. Importantly, among 226 genera studied, 60 genera lack molecular data and are established solely based on morphological features. Therefore, this evidence provides insight into the necessity of intensive exploration for those lacking information to reassess the current fungal taxonomic classification. For example, a molecular phylogenetic study on type specimens may enhance clarity. Additionally, the significant fungal species in relation with potential biomaterial provides the foundation for their conservation.

Significance of fungalpedia in mushroom mycelium-based biomaterials

Scientific identification of fungal species is a crucial factor before their application in mycelium-based biomaterials. The notes on the above-mentioned fungal genera provide important information for mycelium-based biomaterials work. Some key factors of fungal species that affect mycelium-based biomaterials development are listed below (Sydor et al., 2022, Khyaju et al. 2025c, d):

1. The hyphal system type has a significant effect on the mechanical and overall properties of the final mycelium-based biomaterials. Fungal species with trimitic or dimitic hyphal system types provide enhanced mechanical strength and other material properties, compared to monomitic.

2. Fungal species featured with medicinal properties are a top priority in mycelium-based biomaterial development, regarding safety to users from the end products. Additionally, the fungal species that are poisonous or toxic are screened out from being used in the mycelium-based biomaterials sector.

3. The white-rot decay fungi are preferred as they efficiently degrade lignin of plants, a property that is lacking in brown-rot fungi.

4. Saprophytic fungal species are suitable for culture preparation and growing in lignocellulosic substrates or byproducts, which is a fundamental step in mycelium-based biomaterials development (Khyaju et al. 2026).

The detailed note on terms is the first compilation related to mycelium-based biomaterials, easing understanding and encouraging systematic research and development.

Limitations and challenges in Fungalpedia

The preparation of Fungalpedia entries faced some major limitations and challenges:

1. Unavailability of published papers: The compilation of information on all the taxa faced the unavailability of published articles due to their availability restricted to printed form or a lack of a digital copy. Additionally, some articles available in digital form required a subscription or payment to access.

2. Limited information: Fungal genera established with insufficient details on macro- and micro-morphological characteristics pose a major issue in differentiating them from other genera. The provided information might overlap with closely related genera but lacks distinct features.

3. Illustration issues: Basidiomata pictures and morphological drawings are lacking in either the older taxa or the taxa with limited studies. Some taxa lack scale bars in the photo plate, limiting the necessary information on morphology. Additionally, some publications contain incomplete micro-morphological drawings or Figs.

4. Taxonomic and nomenclatural changes: The recurrent changes in taxonomic position and naming are caused mainly by the incorporation of molecular phylogenetic evidence, uncertain placement, and cryptic species (Khyaju et al. 2025d). Regarding taxonomic placement of some fungal taxa, updates among major online databases such as Species Fungorum, GenBank, and MycoBank lack uniformity. Additionally, the estimate for fungal numbers is increasing with the advent of molecular tools and increasing investigation (Hyde et al. 2024b).

5. Uncertain placement (*incertae sedis*): For some taxa, their taxonomic placement might remain unclear. This could be due to differences in the perspectives of researchers on its placement and a lack of agreement. Lacking molecular data results in unclear evolutionary relationships among fungal species. Some fungi might exhibit ambiguous traits, posing a problem to fit to the respective taxonomic level.

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Accessibility of data

All data presented or analysed during this study are included within the article.

Conflicts of interest

The authors declare no conflict of interest.

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